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MAMMALS OF PENNSYLVANIA

by

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Published by

THE PENNSYLVANIA GAME COMMISSION

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TABLE OF CONTENTS

	Page
Opossum	25
Masked Shrew	30
Water Shrew	32
Smoky Shrew	36
Rock Shrew	38
Pygmy Shrew	40
Short-tailed Shrew	42
Least Shrew	45
Hairy-tailed Mole	48
Eastern Mole	51
Star-nosed Mole	55
Little Brown Bat	66
Keen Bat	70
Indiana Bat	71
Leib Bat	73
Silver-haired Bat	75
Pygmy Bat	77
Big Brown Bat	78
Red Bat	81
Seminole Bat	84
Hoary Bat	85
Evening Bat	87
Eastern Cottontail	89
New England Cottontail	94
Snowshoe Hare	97
Chipmunk	101
Woodchuck	105
Thirteen-lined Ground Squirrel	111
Gray Squirrel	114
Fox Squirrel	117
Red Squirrel	121
Eastern Flying Squirrel	124
Northern Flying Squirrel	128
Beaver	129
Deer Mouse	138

TABLE OF CONTENTS

	Page
White-footed Mouse	142
Eastern Wood Rat	144
Red-backed Mouse	147
Meadow Mouse	150
Rock Vole	154
Pine Mouse	156
Muskrat	158
Bog Lemming	163
Black Rat	166
Norway Rat	168
House Mouse	172
Meadow Jumping Mouse	176
Woodland Jumping Mouse	179
Porcupine	181
Red Fox	185
Gray Fox	190
Black Bear	193
Raccoon	198
Ermine	201
Least Weasel	202
Long-tailed Weasel	205
Mink	209
Spotted Skunk	213
Skunk	215
River Otter	219
Wild Cat	223
Wapiti or Eastern Elk	225
White-tailed Deer	230
Identification Key	241
Tooth Formula	248
Measurements and Weights	254
Check List	258
Glossary	262
Wilderness Babies	266

MAMMALS OF PENNSYLVANIA

Dedication

This book is dedicated to the memory of the late Ross L. Leffler, Outdoorsman, Conservationist and Humanitarian, who for twenty-nine years was a member of the Pennsylvania Game Commission, and for sixteen years its President.

Without his cooperation, encouragement and assistance there would have been no Survey of Pennsylvania Mammals and this book would never have been written.

Pittsburgh, Pennsylvania
October 4, 1965

FOREWORD

This book is directed to all those who love the outdoors and want to know more about the mammals which make up a large part of Pennsylvania's wildlife. It is not intended to be a scientific treatise, but is rather a simple explanation of some of the facts of life as displayed by the mammals. It is for the sportsman, hunter, conservationist, student or nature lover.

ACKNOWLEDGMENTS

Many people have contributed to the preparation of this book and to the field studies which preceded it. We should like to give full credit to everyone, but the limitations of space make it impossible. The list of names alone would occupy several pages.

Most of those who took an active part in the field studies are mentioned in the final reports of the six surveys, each of which has been published as a Pittman-Robertson report by the Pennsylvania Game Commission. The Pennsylvania mammal survey was conducted under the Federal Aid to Wildlife Restoration Act of 1937 and was operated as six separate Pittman-Robertson Projects. Field work began in July, 1946, and was completed in June, 1951.

In a broader sense, however, the work began in 1926 when the senior author made his first extended field trip to Potter County and began work at Carnegie Museum under the directorship of Dr. Andrey Avinoff. Early in the 1940's he discussed the idea of a book on the mammals of Pennsylvania with the Honorable Ross L. Leffler, then President of the Pennsylvania Game Commission. To Mr. Leffler, more than any other person, we are indebted for creating, and seeing through to completion, one of the most comprehensive mammal surveys ever undertaken in any state. The 15,000 specimens of mammals collected from all parts of the State are documented by notes and records which fill 84 notebooks, 8½ x 11 inches in size, and 24 card file drawers, as well as maps, photographs and other records.

To Dr. Otto E. Jennings, who succeeded Dr. Avinoff as Director, and to the Museum Committee of the Board of Trustees, especially General Richard K. Mellon, Mr. James C. Rea, Mr. Lawrence C. Woods, Jr., Dr. George H. Clapp and Mr. John B. Semple, we are indebted for moral support and encouragement throughout the project. We are deeply appreciative too, for their generous financial contributions and the creation of a separate mammal survey fund to cover the Museum's share of the expense.

The work was in progress under the administration of four Museum Directors: Andrey Avinoff, Otto E. Jennings, Wallace Richards and M. Graham Netting.

To Margaret T. Doutt, wife of the senior author, we extend our heartfelt thanks for her assistance, especially in relation to botanical problems which arose during the field inspection trips.

Although the manuscript was completed in October of 1963 it seemed to be stuck on dead center and we are deeply indebted to the Mammal Book Publication Committee, Ross L. Leffler, Roger Latham, M. Graham Netting, James A. Thompson, Robert S. Waters and Lawrence C. Woods, Jr. (Chairman) for the major job of getting it underway and seeing it through publication. To General Richard K. Mellon, Chairman of the Museum Committee of the Board of Trustees, we are especially indebted for encouragement and for his efforts in pushing forward the entire project from start to finish.

Roger M. Latham has edited the entire manuscript and we wish to extend to him our sincere thanks and express our appreciation for the many helpful suggestions he has made.

WHAT IS A MAMMAL?

What is a mammal? The definition is so simple it took several thousand years to discover it!

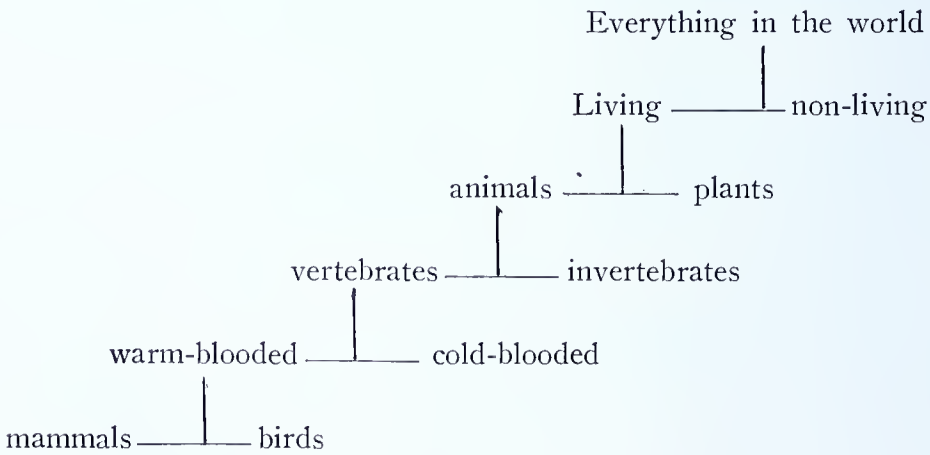
Any animal which feeds its young on milk secreted by the mammary glands of the female is a mammal. No other group of animals feeds its young in this manner.

The term "mammal" was not known until 1758 when the famous biologist, Linnaeus, coined it from the Latin word meaning breast, to classify this particular group of animals. Prior to his time most mammals were referred to simply as animals, or four-footed animals, or quadrupeds. Whales were considered to be fishes.

The word "animal" includes all living things that are not plants (if we may omit here some of the micro-organisms which are hard to classify).

There are many other characteristics which are typical of mammals, but may not necessarily apply to all of them. Most mammals are covered with hair (but it is reduced or lacking in the whales). Most mammals are born alive (except the *Platypus* and *Echidna* in which the young are hatched from eggs). Mammals are warm-blooded; that is, they are able to regulate their body temperature (a feature which they share with the birds). A few other features which are typically mammalian are: 1) a four-chambered heart; 2) the possession of a diaphragm separating the lungs and heart from the rest of the abdominal organs; 3) the possession of seven cervical vertebrae (except in the sloths and manatee); 4) the presence of two occipital condyles on the skull; and 5) the presence of epiphyses on the ends of the leg bones and vertebrae.

Perhaps the mammal's place in the scheme of things can best be shown by a chart.



IN THE BEGINNING

The first comprehensive treatment of the mammals of Pennsylvania was written and privately published by Samuel N. Rhoads in 1903. He called it "The Mammals of Pennsylvania and New Jersey." His subtitle, however, was more explicit: "a biographic, historic and descriptive account of the furred animals of land and sea, both living and extinct, known to have existed in these states. Designed as both a popular and scientific presentation of a branch of nature-study hitherto unduly neglected."

Rhoads spent 11 years collecting specimens and assembling the data for his book. He collected 2,000 specimens, carried on a voluminous correspondence, and had numerous personal interviews with naturalists, trappers, hunters, old pioneers, and frontiersmen in the two states. Working almost single-handed, and with very little financial support, he was able to compile an exceedingly good account of the mammals in the area.

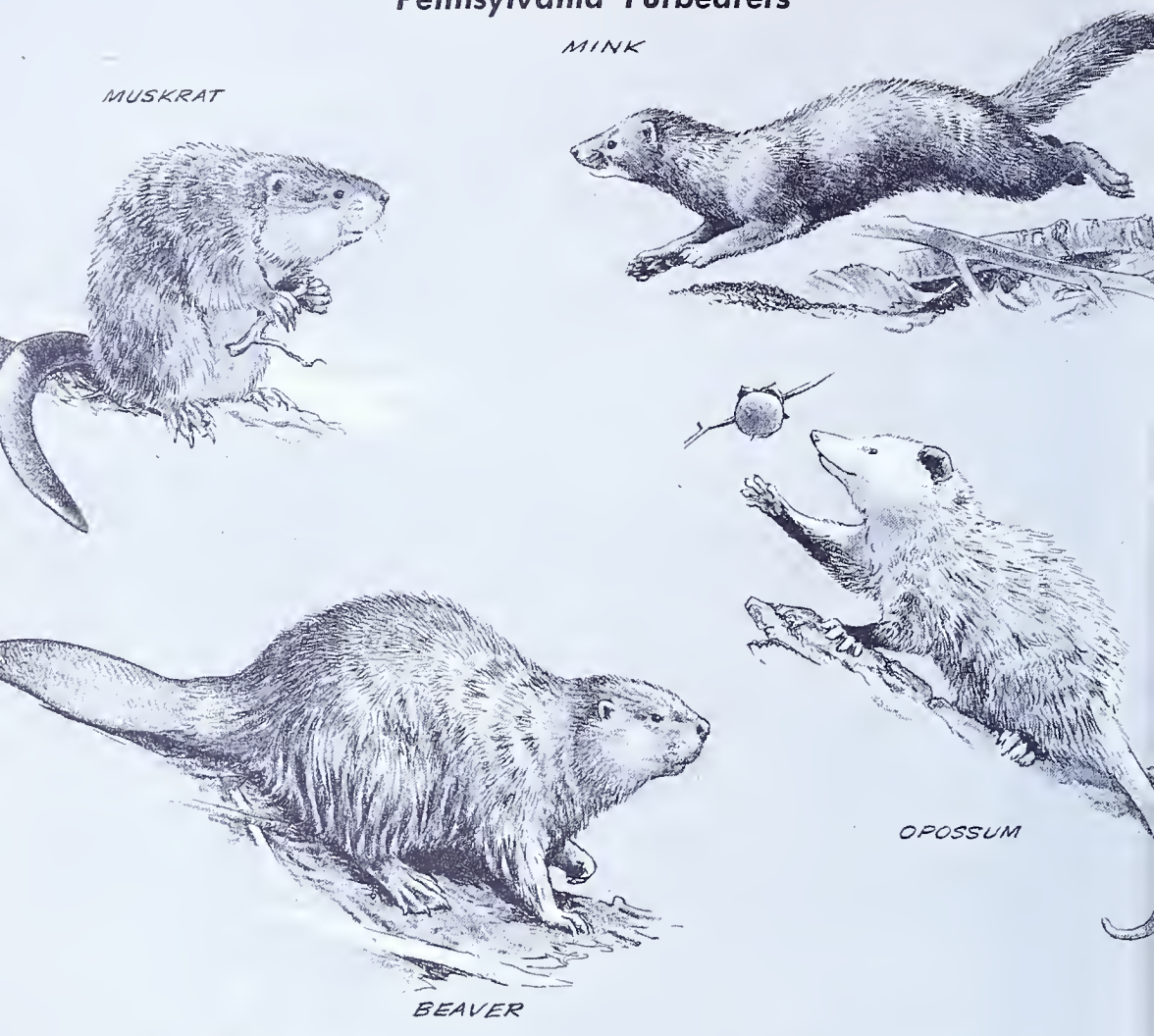
More than 60 years have passed since then, however, and many changes have taken place in the State. Rhoads saw all about him the devastation of the lumbermen and the desolation that followed in their wake. He paints the picture most vividly in a few, powerful sentences:

. . . "Fire, axe, flood, summer sun and winter frost have made the famous hunting grounds and natural game preserves of the Pennsylvania Alleghenies a wilderness indeed. Where once the Canada Lynx, Wolverene, Fisher, Marten, Canada Deer-Mouse, Woodland Jumping Mouse, Northern Hare, and Marsh Shrew found a congenial home, the average mid-summer temperature may now be roughly said to have risen 20 degrees, drought and flood quickly succeed each other, winds become tempests and winter takes on an Arctic severity. Instead of white pines and hemlocks we have scrub oaks and briars; instead of fern beds, sphagnum and moist shade we find bare rocks, glaring sun, and withered vegetation. The grinning opossum sneaks up the south slope as the last snowshoe hare hops down the northern one, and the lowland cottontail forthwith jumps her ancestral claim. While the rifle and the trap remained their greatest enemies, the beasts of the earth and the fowls of heaven had an even chance, but the era of axe and fire and commercialism has doomed them, unless the era of forestry soon rescues them from extinction."

Rhoads saw the wanton destruction of the virgin white pine and hemlock forest and with its passing the annihilation of the game as well; for by the removal of the virgin forest and by the fires which followed, the game was deprived of its food and shelter. He saw the very beginning of the era of reforestation—and saw in it a faint glimmer of hope—hope for a new forest, and a new home for the game and furbearers of our primitive Pennsylvania.

Visits to northern Pennsylvania by the senior author in the early Twenties revealed vistas of burned hillsides, blackened stumps and land that seemed lost beyond all redemption. But now the scene has changed.

Pennsylvania Furbearers



Hardwoods have taken over where the evergreens once grew in such profusion that even on the brightest day the forest floor was dark and gloomy. Just 45 years later the hillsides are again green with a flourishing forest where game may find food and shelter. The summer sun is no longer so hot nor the icy blasts of winter so cold. The forest shelters the soil and its inhabitants. Springs are flowing again, a carpet of leaves and leaf-mold covers the rocks. Deer abound in greater numbers than ever before. To be sure, the wolf, cougar, lynx, wolverine, fisher and marten are still missing and some of them may never return. But in time, there is the possibility that the marten, fisher, perhaps even the lynx and some of the other dwellers of the full-grown forest could return to Pennsylvania.

WHAT'S THE VALUE?

Of all the animals in the world, mammals are most closely related to man, in fact he is a mammal himself. Furthermore, they are of more value to him than any other group of animals, for they furnish him, among other things, with meat, milk, clothing (wool), furs, labor (draft animals such as horse, ox, camel, etc.), companionship (dog, cat) and sport (hunting).

Mammals have lived for the past hundred million years or so competing with one another for food or a place in the sun, or eating one another. But there was no thought of good or bad, valuable or destructive mammals, until about two million years ago when man came along. More recently—perhaps 20,000 years ago, when he began to store up food or other valuable products, he called those mammals "bad" which destroyed his products, and the ones which furnished him with food, furs, labor, or companionship "good."

Until man's coming, there was no ledger on which to enter credits or debits, but now we must annually (or oftener) add up the losses and the profits. Unfortunately, some species have an annoying habit of crossing the line, sometimes adding up on the debit side and other times on the credit. In these days of civilized man, the losses and the credits range into the millions, or even billions, of dollars. It has been estimated that the house rat alone causes more than $200,000,000 damage in the United States each year, and this does not make any allowance for the unestimable damage it causes by the transmission of disease and parasites to man and his domestic animals; nor does it include the damage caused by the house mouse. If these figures were added all together, the losses caused by these two introduced species would be staggering.

Some of our native mice, especially the meadow mouse, at times also cause extensive damage, especially to orchards, forest plantations and field crops. Other species of wild mammals may cause considerable local destruction, too, such as deer, bears, foxes, skunks, raccoons, minks and weasels. However, these species have a value on the credit side of the ledger for their fur, their meat or their sporting qualities. When we speak of sporting value we are not dealing in pennies. It has become big business and, as people have more and more leisure time, they are spending

more time and money on the sports of hunting and fishing. Statistics compiled by the U. S. Department of Interior, Bureau of Sport Fisheries and Wildlife, show that more than 50 million persons engaged in these sports during 1960 and they spent almost $4 billion—*billions, not millions*—for equipment, food, travel, guides, lodging, etc. This was just about $1 billion more than in 1955. This is some indication of what the people of the United States of America are willing to pay for a few days (an average of about 15 days) of hunting and fishing.

Here in Pennsylvania, hunters and trappers purchase almost a million licenses, more than in any other state in the Union, and for these they pay almost $5 million. This is for licenses alone. Additional expenditures for guns, ammunition, clothing, food, travel, and other equipment and services increase this figure by many more millions of dollars. Such expenditures provide some indication of wildlife's economic value for sport, but how does one go about determining its aesthetic value? It seems impossible to place a concrete figure upon the pleasures and thrills which people derive from the sights and sounds of nature, but these are immeasurably valuable, nevertheless.

OTHER VALUES

In addition to these very obvious ways in which mammals are of value to man, they serve his interests in many other ways which are not so obvious. The mole, seldom seen and never heard, is at work day and night in the fields and in the forest, trying to satisfy his insatiable appetite for insects, earthworms and other invertebrate animals which live in the soil. Destroying insect larvae is his business and to this he devotes his entire life. He consumes almost his own weight (50 grams or more) every day and, when this is multiplied by the millions of moles in the State, it is not an inconsiderable amount of insect life which is thus prevented from descending on man's crops and forests. The same things may be said for the shrews. Many larger mammals are insect-eaters too, and spend much of their time in search of this kind of food.

The work that the mole does in burrowing, loosening and turning the soil is of real value, too. The woodchuck is another excavator which aids in turning over the soil and in so doing provides homes for many other creatures which share his burrow with him or adapt it to their own needs after he has gone.

Have you ever wondered how oak, hickory, walnut and other such trees get planted *uphill*? Obviously heavy nuts of this kind can't roll uphill, and even the worst storms can't blow them very far. Squirrels and chipmunks are very important factors in this planting.

Mice serve as food for furbearers. Beavers have value as furbearers but they also build dams which act as settling basins and conserve both the soil and water. Fur values fluctuate from year to year and at the present time they are extremely low, but in some past seasons Pennsylvania's fur crop has been worth $2 million to the trapper and has cost the fur coat buyer a great deal more. Someone has estimated that a deer is worth $30. This seems like a very low figure for the meat alone but,

using this low figure for 100,000 deer (the average annual harvest in recent years) the value would be more than $3 million. In 1964 Pennsylvania hunters killed nearly 1½ *million cottontail rabbits and more than ½ million squirrels.* Hunting is big business!

MAN

Man is the most destructive creature earth has ever borne. With fire and ax and plow and more recently with earth moving machinery and poisonous chemicals he has changed the face of the earth and the life upon it. His changes are comparable to such long time climatic fluctuations as have produced glaciers or deserts, or such extensive movements of the earth's crust as have produced mountains or inland seas. Tornados, volcanoes and earthquakes are mere local irritations by comparison.

It is easy to destroy, but it takes a long time to rebuild. A pine or oak forest can be cut or burned in a few days or a few months, but it takes two or three hundred years to replace. A species of animal can be destroyed completely and once it is gone it can never be brought back to life.

If we were all-wise and knew all the questions and answers we might be in a position to decide which animals should be nurtured and which destroyed, but circumstances change and man changes his mind about which species are good for him and which are not. There are many facts we do not know about the lives of wild animals, and so it is most unwise to attempt the complete destruction of any species. Where it can be shown beyond a reasonable doubt that a given species is causing damage or is a serious threat to some specific interest of man, local control may be instigated, but so often we undertake control or attempt annihilation only to find that the species we were fighting was actually doing more good than harm. In our vast ignorance we have seen only a small part of its life and habits and have overlooked other more important aspects.

HABITAT

The habitat of a mammal is, in its simplest terms, the place where it lives and the place where it finds at least the minimum requirements for its existence. Many things may go into making up a mammal's habitat, but basically two things are essential—food and shelter. Every mammal must eat in order to survive and most must have water to drink. A mammal like the kangaroo rat, however, can derive all the moisture it needs from the digestion of such dry foods as rolled oats and sunflower seeds. Most mammals also need some shelter from the elements and their enemies. But no two kinds seem to have exactly the same requirements and what may be good for one may mean death for another. Thus, mammalian habitats vary widely for the different species. Some species are strictly confined by certain very precise requirements, while others are tolerant of a wide range of conditions.

Basically, the habitat is determined by the nature of the land surface and the amount of heat and moisture which it receives. These factors, in turn, determine the kinds of plants which will grow. Thus a knowledge of the topography, or physiographic areas, the soil, climate and vegeta-

THE WHITE-FOOTED MOUSE is one of Pennsylvania's most common mammals. Found in nearly every section of the Commonwealth, it is a friendly and lovable little rodent. Another name is deer mouse.

tion are essential to an understanding to a mammal's habitat. Many a good trapper or hunter may have no formal education in these matters but, from years of practical experience, he has learned to recognize these factors (perhaps without being able to name them) and knows very well where to look for a mink, raccoon, rabbit, fox, flying squirrel, deer or bear. This, after all, is the important thing when he wants to find his quarry!

PHYSIOGRAPHY

Some of the environmental conditions which influence the occurrence and distribution of mammals in Pennsylvania are described briefly here:

The mountain ridges, valleys, plateaus and rivers which make up Pennsylvania's landscape have had a most important influence on its history and development and especially on its mammalian life. They have formed barriers or highways to movements of mammals; they have made agriculture possible or impossible; and they have determined the location of our factories and our cities. These things in turn have often determined what man has done to the wildlife of the area.

Physiographically Pennsylvania is one of the most complicated of all the states. No less than 9 sections of the physiographic provinces are found within its boundaries.

The entire United States has been divided into 8 major divisions and most of Pennsylvania lies within one of these, the Appalachian Highlands Division. However, a small portion of the Interior Plains Division reaches the State along Lake Erie, and a very small portion of the Atlantic Plain Division crosses the easternmost part of the State. Unfortunately it is not possible here to go into a full discussion of the physiographic provinces of Pennsylvania. For those who are interested in more detail, reference is made to N. M. Fenneman, "Physiography of Eastern United States" (McGraw-Hill Book Company, Inc., 1938) and the references which he cites.

The most obvious feature of the State is the Appalachian Mountain system which runs from northeast to southwest, dividing the State into eastern and western plateau country, with a central portion of steep mountain ridges and deep valleys.

The mountainous areas of Pennsylvania have been too steep and rugged for agriculture. More of this land was cleared than should have been and put into steep side-hill farms. These were not sufficiently pro-

ductive to be profitable, however, and most have been deserted. Many are now producing good stands of second growth forest which, for the most part, is good wildlife habitat.

All of Pennsylvania west of a line drawn through Carbondale, Scranton, Williamsport, Altoona, Wellersburg, and Frostburg, Maryland, lies in the Appalachian Plateaus Province (except a tiny strip along the shore of Lake Erie). In general, this province embraces all of northern and western Pennsylvania. It consists of a fairly high plateau which has been carved by the Allegheny, Monongahela, Beaver rivers and their tributaries, making deep valleys. The ridges are flat-topped and in each section are nearly the same height. The northwestern edge of this province, north and west of a line drawn from Jamestown, New York to New Castle, Pennsylvania, has been covered in the past by glaciers. The huge sheets of ice moving down from the north did much to level the hills and fill the valleys with glacial sand and gravel. Incidentally, they also changed the course of the Beaver river and left much of the area poorly drained. Thus, a characteristic feature of this area is a great number of small swamps and bogs.

Along the shore of Lake Erie there is a small strip of land one to 10 miles wide known as the Eastern lake section of the Central Lowland Province. These flat or gently sloping planes were bottoms of old lakes during glacial times. They are very fertile and flat, so have been cleared and are extensively cultivated. This is an eastern finger of the vast Interior Plains which extends eastward from Kansas and Nebraska through western Ohio and along the Great Lakes into New York. It brings with it a plains habitat which permits certain western species such as the Prairie Deer Mouse *(Peromyscus maniculatus bairdii)* to extend its range eastward.

To the east of the Allegheny Front the country known as the Ridge and Valley Province is very different. Here the crust of the earth has been wrinkled and folded, leaving wide or narrow valleys between steep mountain ridges. The highest peak in the State, Mt. Davis (3,213 feet), is about ten miles east of Confluence, near the Maryland line in Somerset County.

East of the mountains lies another peneplain in the Piedmont Province. This is not nearly as high as the western peneplain and has not been as deeply cut by the rivers. Running through it, in a northeast-southwest direction, are a number of minor folded ridges. For the most part this is low, flat, fertile land which is extensively farmed.

Another markedly different province which barely enters the State near Philadelphia is the Embayed section of the Coastal Plain Province. Its western boundary is marked by the Fall Line, a rather conspicuous feature, recognized by the early settlers even before it was ever studied by geologists. Northward from Chesapeake Bay this boundary is marked by a line of wooded hills notched by many streams which cross it and fall 100 to 300 feet in the course of 2 to 4 miles.

The Delaware and Susquehanna rivers which drain to the east and find their outlets in Delaware Bay and Chesapeake Bay have cut their way right through the mountains. Their headwaters rise in northeastern and northcentral Pennsylvania.

In the western part of the State the rivers originally drained west from the mountains then north into Lake Erie. As mentioned before, however, the glaciers changed the course of those northward flowing rivers so that the Beaver River now flows south instead of north. This change caused the Allegheny and Monongahela as well as the Beaver rivers in the western part of the State to cut a new channel, the Ohio, which flows south and west into the Mississippi.

This brief description of the physiography of Pennsylvania has omitted many of the details which are important from a physiographer's point of view. But it is hoped that this will be sufficient to give some basis for understanding the distribution of wildlife habitats in Pennsylvania.

Nothing is more devoid of wildlife than a newly plowed field. There is neither cover nor food available. It is hard to imagine an area as large as an entire state being plowed in one enormous mass of furrows so that not a single tree, shrub, weed or blade of grass was left. However, if such a catastrophy could occur all wildlife would be driven out or would die. Fortunately this has not been possible in any state, for everywhere there have been stream courses, rocky hills or other obstructions which halted even the most avid farmers. The vegetation left in these places made refuges where wildlife could hide. Once the vegetation grew back on the plowed land, the animals could move out and repopulate it. This is why the lay of the land, the physiography, has had such an important effect on the farms of the State. The steep valleys, rugged hills, and mountains have been refuges for our wildlife and we are indebted to these physiographic features for preserving much of it. The important point to be stressed here is that the use which has been made of the land determines, to a large degree the kind and amount of wildlife it will sustain.

CLIMATE

Fundamentally, the climate of an area is a summation of the daily weather over a period of time. It is dependent upon temperature and moisture, but many other factors enter also, such as wind, evaporation and ground cover. These things in turn affect the soil; and the soil, plus climate and topography, have an important influence on plant cover.

In addition to its influence on plant growth, climate has a very direct affect upon the mammals themselves. Daily averages determine the general nature of the plant and animal species which can live in any given area, but it is climatic extremes which delimit mammal distribution —extremes of heat or cold, wet or dry, which are more than the species can tolerate.

CLIMATE IS AN IMPORTANT consideration in the management of Pennsylvania's deer herd. Bad winters preceded by law hunter harvests can spell trouble far an expanding deer population.

Pennsylvania's climate is temperate. The average January temperature ranges from 32° F. in the southeast and southwest corners of the State to 22° F. in the northcentral and northeastern highlands near the New York line. However, in certain areas such as some of the mountain uplands and high plateau sections, minimum temperatures of –30° F. to –40° F. have been recorded. Likewise, the average July temperature ranges from 74° F. to 76° F. in the southeast and to 66° F. in the northcentral region. Maximum temperatures of over 100° F. are occasionally recorded for many places in the State.

The amount of moisture received by an area is equally important, but many additional factors influence its availability to plants and its effect on the mammals. Such matters as the time of year (winter or summer), the amount of cloud cover, speed of evaporation, and the nature of the soil are some of the factors which determine the "value" of the precipitation. The annual precipitation in Pennsylvania varies from a minimum of 34 inches in central Tioga County to a maximum of 50 inches in Somerset County. A small area in eastern Allegheny County receives only 36 inches per year, but most of the remainder of the county north and east of there receives 40-42 inches. In eastern Pennsylvania much of the area receives 42-46 inches. In the mountainous regions and the high northern plateau region, 38 to 40 inches is more common.

LIFE ZONES

One of the best ways to judge the climate of an area is by observation of the plants which grow there. Perennial plants such as trees and shrubs are especially useful as indicators of climate. If the limits of temperature and moisture required for a given species are known, then it follows that these conditions are present wherever that particular plant is found.

In the 1890's, C. Hart Merriam published a series of papers in which he outlined the effects of temperature in delimiting the flora and fauna of North America. He divided the continent into 3 major regions and 7 "Life Zones" in eastern North America as follows:

Boreal Region — { Arctic
Hudsonian
Canadian

Austral Region — { Transition = Alleghanian
Upper Austral = Carolinian
Lower Austral = Austroriparian

Tropical Region — { Tropical

Merriam divided the Austral region of North America into eastern humid and western arid zones. In the east the division of the transition is called Alleghanian; the Upper Austral is called Carolinian and the Lower Austral is called Austroriparian.

In a general way these zones are very obvious to a traveler as he journeys from south to north, passing through tropical forest, temperate deciduous forest, northern coniferous forest and into arctic tundra. These same zones may be observed as one climbs a high mountain. Thus, in going only a few miles up a mountain one will pass through the same vegetational zones that would be encountered in traveling from the tropics to the poles.

Many other plants and animals are characteristically associated with the indicator plants because they are limited in distribution by similar conditions of climate. Therefore, one may reasonably expect to find the same associated plants and animals wherever he finds the indicator plants. Since these Life Zones are actually climatic zones, Merriam was able to show that they could be used to indicate the kinds of crops which could be grown in any given region.

Life zones work very well in a general sort of way, but if pressed too closely for minute details they appear to break down, especially south of the Boreal Region. Merriam based his zones largely on temperatures, but in later years some biologists have been very critical of his work, and have divided North America into a great variety of plant communities with a bewildering array of names and delimitations (Dice, 1943; Kendeigh, 1932; Shelford, 1932, and others).

These plant communities or biotic provinces, as they are sometimes called, become so numerous and confusing that they no longer serve the purpose of indicating the general over-all climate but rather indicate conditions restricted to relatively small areas. After trying a variety of other classifications, there has been in more recent years a tendency to go back to Merriam's Life Zones, but placing the emphasis not so much on temperature control as on the occurrence of certain indicator plants and animals which are characteristic of the various regions.

Pennsylvania lies in the broad belt of Transition Zone which extends across North America from east to west south of the Canadian Zone. As its name implies, the Transition is an area where northern elements meet and mingle with southern elements. As Merriam pointed out: "The zone as a whole is characterized by comparatively few distinctive animals and plants, but rather by the occurrence together of southern species which here find their northern limit and northern species which here find their southern limit." It is here that the chestnut, walnut, oaks and hickories of the south meet and overlap the beech, birch, hemlock and sugar maple of the north.

Originally the Canadian Zone was found over a fairly wide area in northern Pennsylvania and extended down the crest of the Allegheny Mountains into West Virginia and even as far as North Carolina. The removal of the forest by lumbering and farming has changed conditions extensively. When the forest is removed the land gets hotter and drier and thus creates conditions favorable for more southern plants and animals, so the Transition Zone has expanded at the expense of the Canadian Zone, due to man's activities in the past 200 years.

The Austral (or Carolinian) Zone reaches into Pennsylvania from the south and extends wide tongues up into the eastern and western parts of the State.

Some of the characteristic mammals of the Canadian Zone are the lynx, marten, porcupine, red squirrel, snowshoe hare, star-nosed mole, Brewer's mole, water shrew and northern jumping mouse. Characteris-

ONE OF THE LIFE ZONES of interest to the mammalogist in Pennsylvania is that found in the caves of the Commonwealth. A state with many underground passages, Pennsylvania supports an interesting bat population.

tic trees are the hemlock, sugar maple, beech, yellow birch, black cherry and white pine.

As noted above, the Transition (called Alleghanian Faunal Area in eastern United States) is characterized by a mixture of northern and southern elements.

The Upper Austral (called Carolinian Faunal Area in eastern United States) is characterized by such trees as the sassafras, tulip tree, hackberry, sycamore, sweet gum, redbud and persimmon and such mammals as the opossum, gray fox, and fox squirrel.

During the past 15,000 to 20,000 years there have been extensive changes in the climate of Pennsylvania. Previous to that time an enormous sheet of ice came down from the north bringing with it sand, gravel and huge boulders of granite, quartz, and other rocks very different from the bedrocks of western Pennsylvania. At that time it was very cold and Arctic Zone plants and animals lived here. As the climate gradually got warmer (perhaps 10,000 to 12,000 years ago) the ice began to melt at its southern end and, as it retreated to the north, the Arctic Zone fauna and flora followed it northward. At the same time plants and animals typical of a warmer climate moved northward into Pennsylvania.

An examination of specimens found in a sinkhole near Bedford shows that such northern species as the Yellow-cheeked Vole *(Microtus xanthognathus),* Collared Lemming *(Dicrostonyx),* Heather Vole *(Phenacomys),* and Bog Lemming *(Synaptomys borealis)* occurred there about 11,000 years ago. The climate here in Pennsylvania was not only colder, it was also warmer at times, so much warmer that animals and plants typical of a more southern climate once lived in Pennsylvania although they are not found in the State today. The evidence indicates that the climate has been constantly changing—sometimes warmer, sometimes colder than now. With this change in climate the plants and animals have been pushed southward or northward.

In conclusion, we see a land mass which has been above the sea for more than 200 million years (time enough for the origin and extinction of many kinds of plants and animals). During this time great variations in physiography and climate have occurred. Mountains have been built and eroded away; peneplanes have been created and raised again to start a new stage of erosion; subtropical and arctic climates have come and gone. These occurrences have induced extensive changes in the fauna and flora. The present is only a brief second in this long period of the earth's history, but we can see in the sinkholes and in the solid rocks, samples of the life which has gone before.

ELK HERDS once lived throughout Pennsylvania. In winter they were said to migrate into the shelter of mountains away from water and frozen meadows. Now there are 30-40 elk in northcentral areas as the result of transplants from the West.

EARLY HISTORY OF PENNSYLVANIA MAMMALS

One hundred and sixteen years after the first voyage of Columbus, in 1608, Captain John Smith sailed north along a virgin coast into the lower Susquehanna River. There he met the Susquehannocks.

> "Their attire is the skinnes of Beares and Woolves, some have Cassocks made of Beares heades and skinnes that a mans necke goes through the skinnes neck, and the eares of the beare fastned to his shoulders behind, the nose and teeth hanging downe his breast. . . . One had the head of a Woolfe hanging in a chaine for a Jewell."

These warriors, 60 of them, had traveled down river for 2 days from their village (now Washington Boro, Lancaster County) to see their first White Man.

The Colonial Period had begun. It would take another 250 years for the last wolf howl to die over stump-blackened hills and another century for the green forests to return to Penn's Woods. But things could never again be as they were.

Herds of fat elk waded and splashed in the river shallows during the summer months, feeding on river plants and seeking relief from insects. Their game trails, broad and packed as a bridle path, were utilized by Indians and Colonists alike. Some disguised as modern highways are still in use. These trails often led to "salt licks" where elk and deer congregated in herds sometimes numbering 50 or more to paw at and eat the mineral-laden earth.

Elk occurred throughout the state. They were reputed to migrate during the winter months away from the frozen river meadows into the heads of sheltered mountain coves where they browsed on mast, twigs and buds. Penn's Woods was also bear country and early settlers told of

taking 30 or 40 a year. Certainly elk and bear bones are common finds during the excavation of any Pennsylvania Indian village site. But for all of their size and power, the bear was no menace to the elk and deer herds of these early times.

There were efficient predators abroad, however—the timber wolf and the mountain lion. Both ranged from mountain summit to river bottom. Both were deerslayers. Both were marked for extermination by settlers and some of the earliest American laws dealt with them. A bounty of 20 shillings was paid to "whatsoever Christian shall kill and bring the head of a wolf of prey or panther to any magistrate of any county in this Province" (General Assembly, West Jersey, 1697). Nonetheless, it took over 250 years to exterminate them in Pennsylvania. As late as 1871 Clinton County paid bounty on two mountain lions ($6 each) killed on Big Run in Beech Creek Township. The last Pennsylvania timber wolves may have persisted into the 1890's in some mountain areas. Bounty on wolves ran as high as $25.

In the 12 years between 1808 and 1820, Luzerne County paid bounty on at least 562 wolf scalps. As many as 273 were killed in one year.

As primeval forest was cut and the plow and the cow pushed westward, wildlife fought a losing battle. With the reduction of the deer and elk herds, wolves and mountain lions turned more and more toward settlers' stock. Caught between lack of big game on one hand and relentless persecution on the other, they became extinct in Pennsylvania.

The fisher *(Martes pennanti)* and the pine marten *(Martes americana),* both valuable furbearers, easily trapped, survive only in trappers' tales here in Pennsylvania.

> "That morning [in November, 1821, Kinzua Creek near Smethport] Morrison and Whitcomb set 40 sable [pine marten] traps, called deadfalls; they were so constructed that when a sable came to eat the bait a small log would fall and kill them." At the end of the month: "The receipts were 40 sable skins and 15 deer skins at 75 cents each." (P. Tome)

The last fisher known to have been killed in the state (on Mill Creek, 2 miles north of Bird in Hand, Lancaster County) met an ignominious end. It was shot as a chicken thief. About the size of a fox (and commonly called the black fox or pekan) the fisher is a giant, bushy-tailed, black-brown marten. This powerful, agile animal was widespread in Penn's Woods, but it was incompatible with any way of life save that of wilderness. It was one of two now vanished species (the other being the Pennsylvania elk) that was painted in life by Audubon. This was a handsome animal collected by S. F. Baird in 1844 on Peter's Mountain, 6 miles from Harrisburg.

The former occurrence of the buffalo in the state has never been satisfactorily established. Tales there are aplenty, some fabricated but none substantiated. There is only the evidence of a few place-names in central

and western Pennsylvania to suggest its former presence. This is the one big-game animal whose remains have never been discovered in cave deposits or in the bone debris associated with Indian village sites. At best, there could have been but few within our borders. However, despite the lack of tangible evidence, there were probably small numbers of buffalo at least along our major river valleys. There is strong tradition in central Pennsylvania's inter-mountain valleys that some buffalo persisted there until the late 1700's. Tradition says that the last buffalo killed in Pennsylvania was shot in the 1790's in the McClister farm, five miles from Lewisburg in Union County by Colonel John Kelly.

Probably the most abundant mammal in the state, other than the mice and shrews of the forest floor itself, was the gray squirrel. Thousands of square miles of mast-producing trees bred squirrels by the millions.

> "Mr. Foot . . . had offered a dollar a day to any good gunner who would shoot the squirrels that were destroying his corn. . . . At them we went, shooting sometimes half a dozen on one tree . . . I continued shooting for nine and a half days, till I could see but one more squirrel, and that was a black one." (Browning, c. 1797)

The Colonial farmer really had his problems.

> "A boy belonging to a neighboring family came to us saying that there were three bears in one of their cornfields pulling down the corn and requested me to come and kill them." (Tome, P., c. 1820)

or:

> "The sheep gave me more trouble than all the rest; for if they happened to be out of their pen for only one night, it was ten chances to one that the wolves killed at least one of them." (Browning, c. 1825)

Several species have been admitted to the roster of early Pennsylvania mammals on shaky evidence. For example, tradition and the alleged find of an antler in a salt lick in the Allegheny Mountains near the New York state line over a century ago are the only suggestions that the moose may have strayed as far south as Pennsylvania occasionally.

Another straggler from the north country, the wolverine was a rare visitor. One was trapped on the east fork of the Sinnemahoning in Potter County between 1858 and 1863 by "Uncle J. P. Nelson." There is no other record.

The red fox was not a native Pennsylvanian. Gray fox bones are common finds in Pennsylvania Indian sites, but those of the red fox are invariably absent. Early settlers noted that only the gray fox was found before the forests were cut and that it was not till the 1700's that the red fox began to appear in Penn's woods. The red fox was, nonetheless, a native American. The cutting of the forest eliminated such carnivores as the fisher and the marten, but benefited such forest edge and field

forms as the cottontail rabbit, the woodchuck, and the meadow mouse. This was a situation which the red fox soon exploited and spread its range to the south and east. Recent anatomical studies have ruled out the supposition that our Pennsylvania red fox descends from European stock introduced during the Colonial Period. They are quite distinct from the European red fox in the configuration of the skull and the teeth, but inseparable from other North American red fox populations in these respects.

Much has been written on the mammals of the Colonial Period by the late Col. Henry W. Shoemaker. Unfortunately, he recorded hunter's tales, along with historical accounts, and it is difficult to separate fact from fiction. The great buffalo migrations and moose herds so vividly described apparently did not exist at all. However, Shoemaker did interview many of the last of the Pennsylvania hunters of the 1800's. These accounts are so interesting that it is unfortunate that they cannot be fully substantiated.

We must go to museums to see some of our vanished wildlife. But the bear, the beaver, the wildcat and the deer are with us still. A small herd of imported elk furnish, now and again, a rare glimpse of Pennsylvania as it was a little more than a century ago. Thanks to enlightened game and forestry practice we are not too far from our Penn's Woods heritage. We must keep this so.

THE MOUNTAIN LION and the timber wolf both ronged over the mountains of Pennsylvonio at one time. Both hod o price on their heods os early os 1697. The last bounty was poid on mountoin lions in Clinton County in 1871.

NAMES

How embarrassing it is not to recall the name of an acquaintance when you meet him again, or worse yet, to call him by the wrong name! Names are very important.

It is not only important to have names for things, but it is important that we all call the same thing by the same name. In England the animal we call an elk is called a red deer; the animal they call an elk we call a moose. How confusing! The animal we call a horse is called caballo in Spanish; the rabbit conejo; and the deer venado. The names for the different animals are different in each different language. It would be much more convenient if everyone used the same name for the same animal.

This is exactly what the scientific name does. It provides one accepted name by which any person in any part of the world may know each animal. Scientists have agreed by the "International Code of Zoological Nomenclature" that the name must be in Latin, or treated as if it were a Latin word. When you use the word Hippopotamus, anyone familiar with the scientific terms will know what animal you mean, for this is both the common English name, as well as the correct scientific name, for the animal. When we have two animals which obviously belong to the same group, but are slightly different, we give them the same generic name and then modify this with a more specific word, such as gray squirrel or fox squirrel. Only when using the scientific terms do we put the generic or more inclusive name first—Sciurus = squirrel. *Sciurus carolinensis* would be the gray squirrel; *Sciurus niger,* the fox squirrel. Careful study of these animals reveals that there are more than two kinds of gray squirrels and so we use a third name, known as a subspecific name. For example, *Sciurus carolinensis pennsylvanicus* is the gray squirrel which occurs in Pennsylvania. Farther south we find the southern gray squirrel, *Sciurus carolinensis carolinensis.* Likewise, the fox squirrel of western Pennsylvania is known as *Sciurus niger rufiventer* but the one in Virginia is known as *Sciurus niger vulpinus.*

In zoology the scientific name is printed in italics, or is underlined in handwritten accounts. The generic name always begins with a capital letter, while the specific and subspecific names always begin with small letters.

When one is handling a large number of objects it helps to classify them; that is to put the same kinds of things together. For example, if you had several large boxes full of screws and bolts all mixed up it would be easier to find what you wanted if you put all the same kinds together in separate boxes—in other words, classified them.

First you would separate the screws from the bolts, then the machine screws from the wood screws, and the machine bolts from the carriage

bolts and finally sort them for size. Then it would be much easier to find the bolt or screw you wanted and you would know how many of each kind you had. Classification of mammals is much the same. It is easier to record and find information about them if the animals are classified or put into groups which are closely related. Since mammals have developed from a very few primitive ancestors by a course of natural evolution, they are all more or less related and therefore fall into natural groups or orders.

All the mammals in North America fall into 11 orders, such as bats, rodents, monkeys, carnivores, etc. Each one of these orders is divided into families, each family into genera, each genus into species and each species into subspecies. The classification might be shown like this:

Order

Family

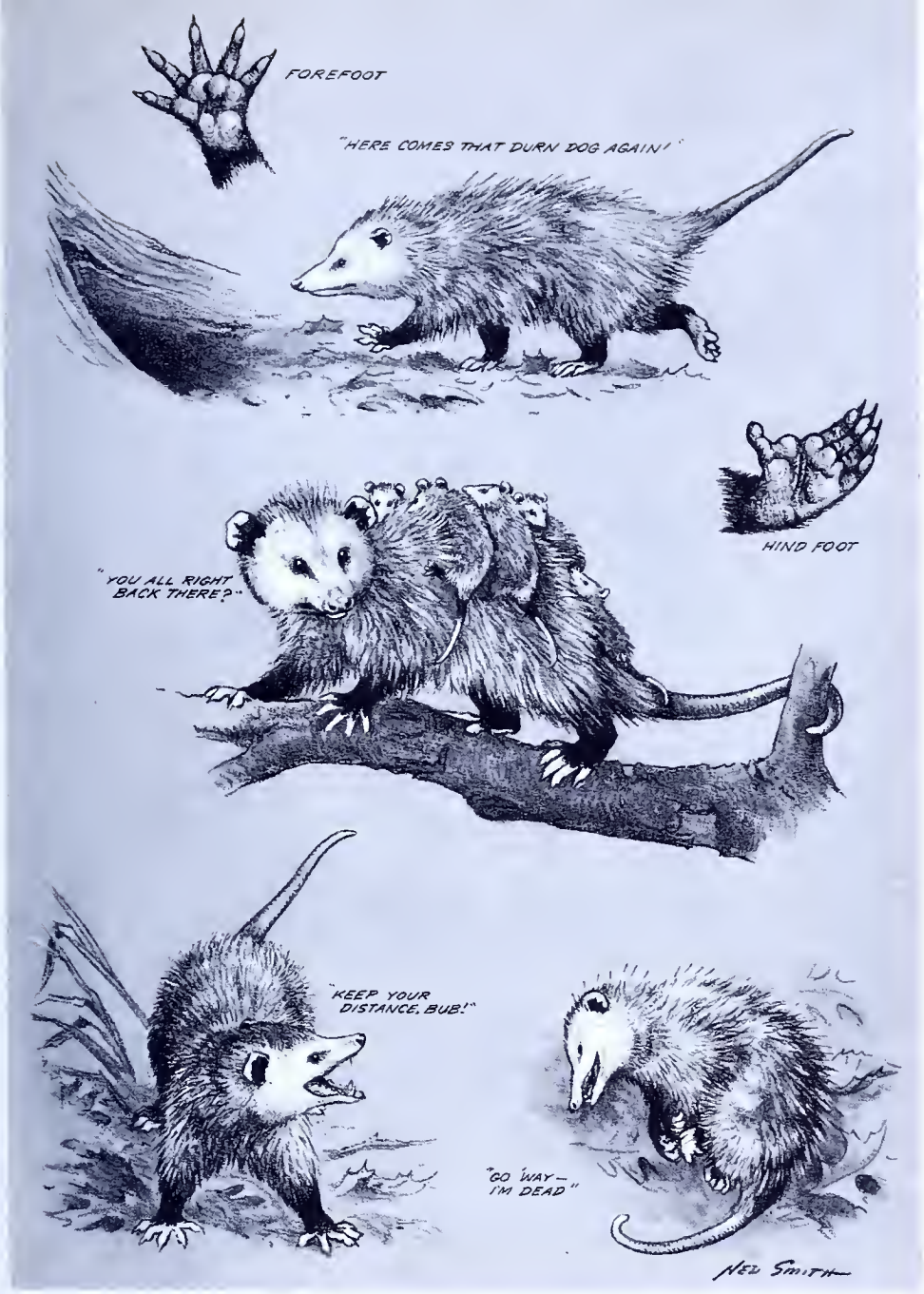
Genus

Species

Subspecies

For example, the order Rodentia includes all of the rodents. There are many families of rodents, such as the squirrels, mice, beavers and porcupines, all of which have certain characters in common and differ markedly from any species found in the Carnivora, such as dogs, cats and foxes. Under the order Rodentia we find the family Sciuridae which includes all of the squirrels. So if you are looking for squirrels you need not look anywhere but in the family Sciuridae. Under the family Sciuridae you will find all the squirrels, such as chipmunks, woodchucks, ground squirrels, tree squirrels, flying squirrels, and others.

About 100 kinds of mammals (species and subspecies) are found in Pennsylvania, but in order to reduce the number of life history accounts the subspecies have been combined under the species in this book.

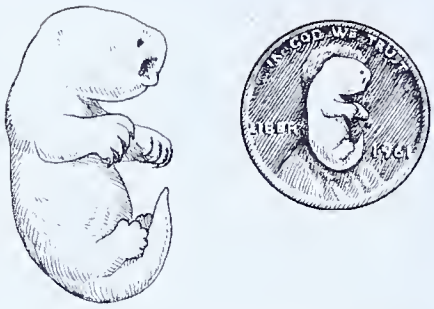


OPOSSUM — *Didelphis marsupialis*

Other names: "Brer Possum"; possum; Virginia opossum, white-face.

It is quite certain that the opossum will never win a popularity contest in Pennsylvania on *any* grounds. From an esthetic point of view it is certainly not attractive. Individually, its pelt is of little value, although the income derived from opossum pelts is substantial, owing solely to the large number of pelts taken.

In the North, 'possum hunting is not an extremely popular sport, although it has its devotees. "Possum and Taters" have never tickled the gourmet palate north of the Mason and Dixon Line, so it is not usually hunted for its flesh in Pennsylvania. But, despite its unattractive



NEWLY-BORN OPOSSUM. ENLARGED PICTURE ON LEFT SHOWS RUDIMENTARY HIND LEGS AND WELL DEVELOPED FORE-LEGS. ON THE RIGHT - AN ACTUAL SIZE DRAWING OF NEWLY BORN YOUNG ON A PENNY.

appearance and deficiency in intelligence, there is still much to be said in its behalf.

The scientific (generic) name of this animal is derived from two Greek words: *di* (two) plus *delphis* (womb); the specific name, *marsupialis* is derived from the Latin word for pouch. Very concisely, this combination of names places the opossum in a unique position in our fauna. It is a marsupial—the only mammal in the United States whose female develops a pouch in which she raises her embryonic young until they are well developed mammals. Many such animals exist below our border, and Australia is full of them, but north of southern Canada and clear to the Arctic circle, no other such mammal exists. This character alone would not enable one to identify just any old opossum. The male does not have a pouch, nor does the female who is not "expecting" have any perceptible pouch. However, there *are* other identifying characteristics.

The opossum is about the size of a house cat and comes in all varieties of gray. The coat is long, shaggy and rather coarse, with a dense, soft undercoat. The ears are rather large, upright and naked. The tail is quite long, naked and prehensile—in other words, the tail has "hand-like" attributes. Both the forefeet and hindfeet have five toes, each with a attributes. Both the forefeet and hindfeet have five toes. The first toe of each hindfoot is large, nailless and acts like a thumb. The head is narrow and the muzzle is pointed and the mouth is very full of teeth (a total of 50, more than any other North American mammal)! The eyes are black and beady, set off by the rather short, light hair of the face. The first impression one gets on meeting the opossum is that of a chunky, grinning, drooling, toothy, shaggy, rat-like creature! About 6 to 10 pounds would be good weight for a mature animal.

This mammal is literally a living fossil. It has remained practically unchanged since the Cretaceous Period, some 90 million years ago. Its early ancestors consorted with dinosaurs, flying reptiles and other equally bizarre and extinct animals. Styles changed during the geological ages and dinosaurs became as obsolete as last year's car. But like the classic Rolls Royce, the opossum retained its identity. There just didn't seem any need for change. Here was a mammal that was non-aggressive, adaptable, would eat almost anything, and was capable of producing a great many young. The Creator looked and found it good. Why change the model?

The opossum was truly a matter of wonder to the early explorers of Pennsylvania. One such explorer, Richard Frame, writing in 1692, "A short description of Pennsilvania," had this to say for it:

> "Yet here are things of a more stranger shape
> The Female Possum, which I needs must tell ye
> Is much admired with her double Belly;
> The Belly for her meat, she hath beside
> Another where her Young Ones use to hide."

The present range of the opossum encompasses the Commonwealth. At the dawn of the twentieth century the picture was different. The northern counties were opossumless and temperatures were lower. As devastated forests recovered and the temperatures rose, so the opossum adapted himself to the change. He moved north—albeit slowly but inexorably. Frost-bitten ears and shriveled tails bore mute witness to sudden cold snaps. The call of the northland could not be resisted. Suitable home-sites were available and the prospects were enticing. New vistas lured these unglamorous, plodding homesteaders northward. So they infiltrated, not aggressively, but quietly and persistently through Pennsylvania, into upper New York and on into southern Canada. Adaptability and persistence—these are hallmarks of the opossum clan!

The needs of the opossum are really very simple. Almost anything to eat and almost any place to live! Insects, carrion, berries—anything goes. A vacant squirrel's nest, an abandoned woodchuck burrow, a hollow log, or a cozy hole under a porch—that's home. The northland has more than enough to meet his requirements; why worry about a few frozen tails and ears?

So, we have a mammal equally at home from sea-level to mountain-top. Wherever there is water, woods, brushy areas and food—and a passable climate—the Virginia opossum can make itself at home. It is a fairly strong and quite adequate swimmer, but indications are that large bodies of cold water might prove effective barriers. Recent experiments tended to show that long immersion in cold water distressed this southerner.

Because it is a unique mammal in the United States, a great many speculations, myths and just plain falsehoods have fogged the true picture of its life processes, particularly about its manner of mating. One deeply

entrenched belief is that they breed through the nose! With the exception that the male opossum has a bifurcated (forked) penis and the female has a double, or forked, uterus, opossums breed in precisely the same manner as other mammals. In Pennsylvania the breeding season is late February or early March. The young are born after a very brief gestation period—13 days, with a possible variation of only 12 hours. To all intents and purposes they are really embryos; the hindquarters are not developed and the body is pink and hairless. It would take 23 of them to weigh as much as a United States penny! As many as 25 young may be born, but since the female has only 13 nipples, the entire litter cannot survive. Usually only 6 to 9 survive.

During pregnancy the female's pouch, which has been barely discernible, increases 40 percent in size. When the young are born, she sits up with her neck arched and her head down as the ½ inch long youngsters emerge and immediately start to "swim," hand over hand, up the hair of the belly and into the pouch. This is what has given rise to the myth about the opossum blowing the young into the pouch. She has her nose so close to the pouch that it is difficult to observe the fact that she is not taking an active part in the procedure. Once inside the pouch each individual that is lucky enough to find a nipple takes hold immediately and remains attached until the time of weaning. The others must die. The nipples enlarge rapidly, and a bulb forms on the end. This makes it extremely difficult to detach the young.

The young grow rapidly. They double their birth length in 10 days; in 50 days they are 2¾ inches long; and by 90 days they are 7¾ inches long. When they finally emerge from the pouch they climb all over the mother and ride about on her back. This has given rise to another old wives' tale. It is a common belief that the female arches her tail over her back and that the young hook their tails over hers in order to hold on! This idea was first foisted on the world by a picture done in 1717, to illustrate the Surinam opossum. Since that time, one naturalist after another has perpetuated the fallacy, using modifications and improvements on the original drawing. One naturalist actually used a photograph to illustrate this method of accommodating the young, but under investigation it was found that the animals involved were stuffed and placed in the position desired! It has only been recently—within the past 10 years—that anyone has bothered to ascertain that an opossum cannot carry her tail arched over her back!

The opossum is primarily a solitary animal. With the exception of the female with her unweaned young, it lives and travels alone. Basically it is a nocturnal animal and during the night it may cover a distance of ½ to 2 miles if a food supply is not readily available. Its normal range covers perhaps 10 to 50 acres. It is not extremely uncommon to see one abroad during the daylight, even during winter, when the terminal third of the animal's tail may be nothing but vertebrae! Sometimes a lean, hungry animal is forced to hunt.

The opossum does not hibernate but, during extremely cold weather, it may stay in its den for several days, if the pangs of hunger do not drive it out. Being of southern origin, it does not store up food to prepare for the long, lean cold days. It does take on a heavy layer of fat to protect itself against the cold, however.

While the opossum is a relatively silent mammal, it can growl, moan, hiss, make a sort of wheezing bark, and at times, a clicking sound. The latter is usually made by the male during the courtship period. When one corners the opossum, its customary reaction is to open its mouth and hiss. In so doing it usually acquires what is to us a rather silly grin, and for some reason, it nearly always drools. With a mouthful of very apparent teeth, it presents a rather formidable appearance. It can bite, of course, but unless one tries to pick it up, it does not attack. Everyone knows the expression "playing 'possum." This trick may or may not be a defense mechanism. Some think that fright makes it faint. Others think that it plays dead deliberately, because most attacks cease when the animal is presumed to be no longer alive. So far as is known, the question remains unanswered at present.

Very few people have considered the opossum to be a good pet. Most think that it is rather stupid; some that it is unbelievably stupid; while a very few have felt that it is too sensitive to be tamed unless handled with extreme care. It would appear that its hearing is not keen in the lower range of sound and its eyesight appears to be extremely myopic. However, its sense of touch is keen and it has a highly developed sense of smell.

The opossum has many enemies but man is his worst. Birds of prey take some young; dogs, foxes, and other mammalian predators take their toll; but the highway is one of the opossum's greatest hazards. Slow, nearsighted, intent on food (usually highway carrion), he waddles slowly into the path of highway traffic and many make no attempt to avoid him. Diseases and parasites also play havoc with Brer Possum as they do with most animals whose food habits are so all-inclusive.

Man pursues the opossum for its pelt, sometimes for food, but mostly because he considers it "vermin." The last accusation is not altogether deserved. True, it does occasionally raid the chicken coop and it does steal eggs, but insects and carrion are its mainstay. In retaliation, all the opossum can do is "play dead" and procreate.

Subspecies: Didelphis marsupialis virginiana Kerr

Range: Throughout the State.

MASKED SHREW — *Sorex cinereus*

Other names: Cinereus shrew; common shrew.

A squirrel hunter waiting patiently for a shot may hear a rustling of dead leaves at his feet and catch a momentary glimpse of a small, brown animal, with a pointed, rubbery snout, and tiny, pinhead eyes. It may be the masked shrew. The cat will occasionally bring one home to grace the doorstep. A shrew with a tremendous range, *S. cinereus* may be found from Alaska on the west to Labrador on the east, an area of over 4,000,000 square miles (almost the entire northern half of North America). A census of the total population would run to untold millions, yet, how many have ever seen one?

The masked shrew is the smallest of the 7 species of shrews regularly found in Pennsylvania. A typical specimen is just over 2 inches long, its body no bigger around than a woman's finger. The tail is proportionately long and adds another 1¾ inches. Its weight, about 3½ grams, just equals that of our eastern hummingbird. The eyes are small, the ears almost hidden in the fur. The snout might almost be classed as a proboscis. It extends far beyond the mouth, and is capable of considerable movement, like a rubber hose. This nose is one of the shrew's main tools as well as his trade mark.

One will search in vain for the masked shrew's mask. It is not apparent enough to be of any aid in identification. In the winter *S. cinereus* wears a rather pleasing coat of lax dark brown fur, shading to gray on the belly. This is replaced during the warmer months by a shorter coat of dull gray-brown.

This shrew may be confused with the larger smoky and rock shrews. The rock shrew has a longer (over two inches) untapered tail, and dark slate colored fur. It is also a very rare animal. The smoky shrew is usually larger and heavier. It is somewhat grayer in color, especially in its winter coat. To further confound the issue, these two species vary in size and color within themselves. A small smoky shrew and a large masked shrew may look confusingly alike in the field.

The masked shrew is externally indistinguishable from the pygmy shrew *Microsorex hoyi*. The pygmy shrew is slightly smaller, a matter of a few millimeters (one of the smallest mammals in the world), its tail is slightly the shorter, but, other than that, they are like two peas in a pod. Fortunately there are excellent and clear-cut ways of differentiating between them by examining the upper teeth.

The masked shrew will tolerate a wide variety of habitats, second in this respect only to the short-tailed shrew *Blarina brevicauda* among Pennsylvania insectivores. This little shrew, like gold, is where you find it. It is primarily a woodland creature, where it occurs under cover of fallen logs, in leaf-littered forest mold, under rock-piles, along stream banks and cliffsides of cool hemlock ravines, swamps, meadow swales and

spring runs. Often they will venture out into the fields, along hedgerows or stonewalls. They are occasionally trapped in mouse runs in the open meadows, or in dry, fallow fields. In the eastern part of the State, the masked shrew is more commonly found in open fields, both wet and dry.

Like most insectivores, the masked shrew will eat a great variety of smaller creatures, insects, spiders, snails, crustaceans, worms, and any carrion it can find—a dead bird or mammal. Captive shrews have killed and eaten each other. Shrews are well-equipped for a carnivorous life. Their teeth are sharply cusped, the molars made for mincing. The front teeth are greatly enlarged and come together with an action that combines the motions of both scissors and forceps, deadly efficient for reducing a struggling insect, a centipede, or a luckless spider into bite-sized fragments.

It needs every bit of this equipment just to stay alive. Such a small mammal as this has very little body tissue with which it can build and maintain a constant body temperature throughout the year. To compensate for the small size of the furnace, the draft is turned up, or, to phrase it more scientifically, the metabolic rate of these tiny mammals is exceedingly high. In physiological tests, this shrew consumed more oxygen for

MASKED SHREW

its size than any other mammal tested, with the exception of the bats. Energy requirements are so high that this shrew can starve to death in a matter of hours. Every movement it makes is rapid. Its jaws works so quickly when it eats that their motion is hard to follow. This little animal, if it manages to elude all of its many enemies, will be dead in 18 months from old age!

Paradoxically, most of what is known about the life history of the masked shrew has been learned from dead ones. A deer, a squirrel, a bear, or a rabbit, carry on their activities where they can be seen. No one has yet successfully solved the problem of spying on a shrew. Consequently, the life histories of these small mammals are largely inferential, based on information obtained from trapped specimens.

Although they will occasionally venture out on the surface of the ground, these tiny animals spend most of their lives in a maze of subsurface tunnels which riddle the deep woodland soil. Very often, when an old log is rolled over, its well-trodden little runs, the shrew itself, or its nest, a fist-sized ball of dead leaves or grasses, may be found under the log.

Breeding activity begins in very early spring, reaches a peak in April and May, and continues on until fall. Litters of from 2 to 8 tiny young are born after a gestation period of approximately 3 weeks. The young are born naked and helpless, but grow at a phenomenal pace and are out making their own living at the end of a month's time. There is evidence that females have more than one litter a year. Some years it can be found in great numbers, at other times it is scarce and local.

These shrews are not as abundant in Pennsylvania as they are in some parts of their far-flung realm, although they are by no means rare, and should be considered as one of our commoner small mammals. Except in the mountains, where it extends its range as far south as the Great Smokies of Tennessee and North Carolina, the masked shrew finds the southern limits of its range in Pennsylvania. It becomes rare or is altogether absent in southwestern Pennsylvania (except on mountainous Chestnut and Laurel Ridges, where it is common). South and east of the Allegheny Mountains, in the rolling countryside of southeastern Pennsylvania, the typical northern race, *Sorex cinereus cinereus,* (Kerr) is replaced by the slightly smaller subspecies, *Sorex cinereus fontinalis,* (Hollister) which is found south to tidewater in Maryland and northern Virginia.

Subspecies in Pennsylvania: Two as follows:

Sorex cinereus cinereus (Kerr)

Range: Throughout the state except the extreme southeastern and southwestern corners.

Sorex cinereus fontinalis (Hollister)

Range: Southeastern corner of the state from Northampton, Lehigh and Schuylkill Counties southward. Specimens have also been taken in Bedford and Franklin Counties.

WATER SHREW — *Sorex palustris*

Other names: White-lipped shrew; eastern marsh shrew.

Streamlined is a good word to use in describing this little water-loving insectivore. The trim water shrew has none of the fragility of the smaller, long-tailed shrews nor the stodginess of the mole-like, short-tailed shrews. The animal measures approximately 3 inches from nose to rump, plus another 3 inches to the end of the mouse-like tail. Water shrews weigh

from 10 to 16 grams (approximately 1/3 of an ounce), and are the second largest shrew in the State. The short-tailed shrew, weighing in at ½ an ounce, is the largest.

The unique feature of the water shrew, and one that is a direct adaptation for a life in the water, is the big "feathered" hind foot. The hind

WATER SHREW

toes are elongated and only slightly webbed, but a comb-like border of stiff hairs, looking like misplaced eyelashes, runs along the sides of the toes and the foot itself. This heightens their effectiveness as paddles, by increasing their resistance to water, as the shrew kicks its way about under the surface. The same fringe of hairs and elongated hind feet is found in another totally unrelated water mammal, the muskrat. The tail, however, unlike the muskrat's, is round and has not been modified for an aquatic existence.

Sorex palustris (palustris—"of the swamp") from the Latin meaning, is black, faintly grizzled with silver on the back. The intense black of the upper parts shades to a dirty gray on the belly, which becomes lighter on the throat and chin (hence the subspecific name applied to the geographic race inhabiting the State, *albibarbus* ("white-bearded"). The tail is covered with short, brown bristles, and in some cases is bicolored, *i.e.,* lighter beneath, darker above.

The fur of other aquatic mammals found in the State, such as the beaver, the muskrat, and the nutria, is composed of two distinct layers, a very dense, shorter underfur, and the longer, coarser guard hairs. Ordinarily the underfur, which is really what keeps the animal warm and dry, is completely hidden by the guard hair layer. When these animals are in the water the guard hairlayer becomes wet and they will emerge on the bank wet and dripping. The dense undercoat, however, has held within it a layer of trapped air which completely blocks off the water, operating on the well-known principle that two objects, in this case a gas and a liquid, cannot occupy the same space at the same time, and the animal itself never gets wet. In the case of the water shrew (and all other Pennsylvania shrews and moles) the fur is not so nicely divided into these two layers. The entire pelage is so dense that water cannot penetrate it, not because of any special water-proofing qualities of the hair, but primarily, because of that trapped blanket of air that surrounds

the furred portions of the shrew. As a result, the water shrew emerges from the water as dry as a duck, and when submerged looks like a large, self-propelled bubble, or a small, silver submarine.

This shrew is perhaps more characteristic of the Canadian north than it is of Pennsylvania, although they have been taken in the Appalachian Mountains as far south as North Carolina. It is an animal of the trout streams, the lake country, and the mountains. The water shrew may be expected to occur along the clear, cold brooks of the northern half of the State, and, with decreasing frequency, south along the mountains. It has been taken in Bradford, Luzerne, Mifflin, Monroe, Potter, Somerset, Sullivan, and Wyoming counties. Potter County marks the known western limit of this shrew in the northern portion of the State. It has been reported from the Allegany State Park, however, just over the Pennsylvania border in New York State. There are only two records for the southern half of the state—along tumbling Cove Run in the Negro Mountains of Somerset County and along Tea Creek in the Seven Mountains area of Mifflin County. Even in those areas where it occurs in greatest numbers, the water shrew is not a common animal and is, apparently, distributed very unevenly. Little colonies turn up here and there in what would appear to be uniformly optimum habitat. This makes the capture of a water shrew as much a matter of good luck as good management, and they occur, without a doubt, over a much more extensive area of the State than the present records show.

This amphibious little meat-eater is almost never found more than a few yards from the nearest water—a spring, a mountain lake, or, most commonly, the banks of a swift upland stream where quiet pools alternate with white water riffles. Here this otter-like little animal searches the stream banks, and, at times, the streambed itself, for any animal food that it may run across. Those who have been fortunate enough to catch a glimpse of the living animal, usually late in the day while they are wading upstream quietly casting for that "big one," never fail to remark with what ease it swims and dives. The water shrew has been seen running along on top of the water for short distances, like a water strider, floating and bobbing about like a cork, and darting about underwater with all of the ease and facility of the otter. It can remain submerged for about fifteen seconds, but only while swimming vigorously. The air trapped in the fur makes it as buoyant as a cork. If it stops swimming, the little shrew will pop up to the surface like a beach ball.

There is a lack of information as to just how it does swim. Some observers have seen it swimming with a dog-paddle motion, using all four feet. It has also been observed swimming much as a frog does, kicking its hindfeet in unison. The water shrew depends upon its specialized hind feet for the major source of propulsion. The tail plays no part in swimming but may aid the animal in making quick turns while submerged.

Water shrews are active throughout the year. Like all shrews they are exceedingly active and alert little animals. Insects and other small

invertebrates, both aquatic and terrestrial, form the bulk of the diet. Small aquatic flatworms *(Planaria)* have been reported from water shrews' stomachs and it probably feeds on a variety of small water animals such as, snails, worms and insect larvae. Small fish have been taken and there is a report of this shrew feeding upon trout eggs in a fish hatchery. Konrad Lorenz, commenting on the hunting habits of his captive European water shrews *(Neomys fodiens)* noted that prey was located underwater entirely by touch. The long whiskers which the shrew laid back along either side of his head while actively swimming, were extended stiffly out to the sides while the animal was casting about for prey. He points out that underwater the sense of smell would be useless to the shrew and suggests that the whiskers may pick up water vibrations which have been set in motion by the shrew's intended victims, thus guiding the all but blind little animal. Just how this would work in a tumbling mountain stream instead of the quiet aquarium where the observations were made, and whether it is also true of the American water shrew, remains to be demonstrated.

These shrews ordinarily live in bankside burrows, the entrance often concealed deep between spray-glazed boulders or between the gnarled roots of a leaning streamside hemlock. Small surface runways are usually found under cover of bank overhangs, fallen logs, brush piles or other debris.

Beyond the fact that they obviously do breed, there is little else that can be definitely stated about the life cycle of the water shrew. By analogy with other shrews of the genus *Sorex*, it breeds annually, possibly more than one litter a year being produced. Breeding activity is confined to the spring and the summer months. Litters may be large, possibly as high as 7 in a litter. The entire lifespan of *Sorex palustris* is about 2 years. The average shrew lives less than a year.

If turn about is fair play, then nowhere is this more vividly demonstrated than it is in the case of the water shrew and the trout. Nice plump water shrews are eagerly snapped up by trout. In some instances the only record of the presence of this animal in a given area has been based upon specimens found in fish stomachs.

The importance of this little shrew to man, and especially to the trout fisherman, is *nil*. It is not common in Pennsylvania. While it does occasionally indulge in small fish, the inroads it makes upon either fish, or upon potential fish food, is negligible. It is a most curious and interesting little mammal which the fisherman or the hiker may occasionally chance to see, as it pokes along a streambank or dives into frigid waters.

Subspecies in Pennsylvania:

Sorex palustris albibarbis (Cope)

Range: Mountainous areas of northern and central parts of the state.

Other names: None other in common use.

There are two situations in which an outdoorsman may have already made the acquaintance of this tiny insectivore. He may have been trying to get to sleep in a hunting cabin or summer cottage and, finally tiring of the scurrying of little mouse feet, magnified by the night out of all true proportion, he set a few mouse traps about the premises. The morning yielded a dozen of those white-footed revelers—the deer mice—without which no woodland cabin is quite complete. But included in the catch he may have found a small, gray creature with a rubbery snout, an underslung, shark-like jaw, no apparent eyes, and a mouse-like tail. That was a shrew. Or, walking along a forest path, scuffing the autumn leaves as he went, he may have found a dead smoky shrew lying at his feet.

When alive, these secretive little mammals are rarely seen, but in those sections of the State where it occurs, it is a fairly common shrew. Its numbers, however, rise and fall from year to year, so that the word "common," in terms of its actual abundance in any one place and at any one time, has little meaning. However, in relation to the many other four-footed denizens of the forest floor, it is a common animal.

About 4½ inches long, including the 1½ inch tail, this shrew resembles a small house mouse but for a few basic anatomical points—the long trunk-like snout, the reddish-brown teeth, the hidden, pinhead eyes and the five-toed front feet—characters common to all shrews. During

SMOKY SHREW

the winter months the smoky shrew wears a dense coat of dark gun-metal gray, shading to slightly lighter on the belly. This is replaced during the summer season by a shorter, somewhat browner, coat. The tail is sparsely haired and darker above than beneath. The weight of about 6.5 grams (approximately 1/5 of an ounce) is substantial as far as shrews go, but is about 1/3 the weight of a common house mouse.

There are three other species of *long-tailed* shrews in Penn's Woods and all are built along much the same lines. The masked shrew *(Sorex*

cinereus) is smaller and browner; the rock shrew *(Sorex dispar)* has a *longer, heavier tail,* and the belly fur is *not* lighter in color; the water shrew *(Sorex palustris)* is much *larger and blacker* with *elongated hind feet* and an *aquatic* habitat. The pygmy shrew *(Microsorex hoyi)* is *smaller, browner,* and *infinitely rarer,* with a different arrangement of unicuspid teeth.

The smoky shrew is most abundant in cool woodlands. In areas where the soil is loose and rich in organic matter, in the deeply-shaded hemlock ravines of the southern counties, in the rocky recesses of the mountains, in the maple-beech-birch forests, and in the spruce and sphagnum bogs of the northern counties, you will find these little insectivores. Their runways, taking advantage of every bit of surface cover that nature affords, meander through the forest soil, around rocks, over buried roots, under and, at times through the wood of decaying logs. A mouse trap baited with peanut butter or bacon and set crossways on a mossy, fern-shielded rock ledge, or deep under the spreading roots of a grandfather hemlock, will often catch one of these secretive little trolls. Occasionally *Sorex fumeus* will leave his subterranean runways and rummage myopically about on the surface for food or nesting material.

The nests, globular affairs of dried leaves or grass, are well hidden, deep within rocky crevices, under rotting logs, stone piles, or old boards. Here the young, averaging about 5 per litter, are born from March through July or August. The number of litters a female produces per year is not known but the long breeding season would indicate more than one. As is the case with most small mammals, initial growth is very rapid. Born looking like little pink grubs, the young are fully furred, almost adult size and completely independent within a month's time. Young adults may be spotted by the bristly tail tip and the unworn teeth. Old veteran shrews will have the end of the tail bald, presumably from dragging it along with them wherever they go, and their teeth will show signs of wear. At 2 years of age this incessantly active little dynamo will have worn its teeth to stubs. Few indeed are the individuals that manage to survive to that extreme age; the majority are lucky if they last a single year.

The smoky shrew cleans up copious quantities of ground-dwelling invertebrates—insects, snails, spiders, small worms—whatever it can kill with ease or that it happens to pick up as carrion.

Only its secretive habits and possibly its odor protect this tiny insect-eater. Many carnivores, such as the domestic cat, turn up their noses at a shrew, presumably because of the distasteful smell of their large lateral skin glands. This doesn't seem to deter Puss from killing them, however, and they are often dragged in to grace the back porch. Birds of prey, having no sense of smell, are not deterred in the slightest from dining on smoky shrews, and snakes may take a great many. Life is short for these smallest of mammals—the shrews.

The smoky shrew is restricted to eastern North America. In the south it is confined to those ecological islands, the cool summits of the southern Appalachian mountains. Further north this little burrower comes down off his mountains, yet shows a preference still for cool, moist surroundings. Common, exceedingly voracious and savage (in a pint-sized sort of way), active 12 months out of the year, these bug-thirsty mites play a part in controlling the teeming invertebrate life of the soil.

Subspecies in Pennsylvania: Sorex fumeus fumeus Miller

Range: Throughout northern and western Pennsylvania, wherever suitable habitat occurs; scarce in the hill country of southwestern Pennsylvania and completely absent from the coastal area of the southeast.

ROCK SHREW — *Sorex dispar*

Other names: Big-tailed shrew; long-tailed shrew.

Sorex dispar, when translated, means the "different shrew." This nimble little insectivore is really a product of the Appalachian Mountains. It can be found nowhere else in the world, but in or near this geologically ancient range of mountains, which extend from Maine to Georgia.

This rarely captured shrew is easily mistaken for the common and wide-spread smoky shrew. This is particularly true during the winter months when both animals wear the same shade of dark gray. There is this difference, however: the coat color of the smoky shrew will be

ROCK SHREW

lighter on the belly than it is on the back. Not so with the rock shrew, where the underparts are quite as dark as the back, as if some one had lifted him up by his long tail and dipped him in a barrel of soot. During the summer the smoky shrew turns a dull brownish gray which differs markedly from *dispar's* intense gray-black fur.

The big-tail is this shrew's trademark, summer or winter. It is sparsely haired, rather heavy in appearance, and slightly *over 2 inches* in length. (This is ½ inch longer than the tail of the smoky shrew.) *Sorex dispar* averages slightly less than 5 inches long, including the tail, and weighs about 5½ grams (it would take about 8 of these animals to balance a chicken egg on any pair of scales).

The slim rock shrew's snout is the longest of any Pennsylvania mammal (in proportion to the rest of its body)—a real hose nose. The remarkably flattened profile of the head, plus the lengthened snout and the long, heavy tail, may be adaptations to its life deep among the rocks. This is truly the rock shrew. From New England south to the Great Smokies it is closely associated with one type of habitat—rockslides in cool, moist situations. Here it lives deep in the subterranean tunnels that occur naturally among the tumbled boulders. The typical habitat of the rock shrew is found where winter lingers latest and creeping plants mantle the slide rock, under the cool shade of hemlocks, birch, and maple. One such spot near Ganoga Falls, Luzerne County, was described as follows:

"The steep side of the ravine here is covered with boulders and blocks of sandstone with deep subterranean passageways. A carpet of moss covers the rocks, and ferns grow in profusion. The hillside has a northern exposure and the direct rays of the sun seldom if ever reach the forest floor. Water in many places continuously drips from the outcropping rocks at the base of the slope—rocks which are virtually padded with liverworts and mosses."

Occasionally they occur in much drier spots but are almost invariably associated with rock crevices and sliderock.

The rock shrew is such a rarity, even in its mountain strongholds, that trapping one becomes quite a challenge. This elusive shrew has been affectionately referred to by collectors as *Sorex "despair."*

In Tennessee and North Carolina these nimble little animals are found at altitudes of from 4,000 to over 6,000 feet—real hillbillies. In the much cooler state of Maine they have been taken at an altitude of only 1,000 feet. In Pennsylvania they occur at altitudes that range from 900 to 2,300 feet, seeming to prefer the lower mountain slopes to the crests. The crests of the mountains are very often too well drained and dry. Their slide rock haunts occur more typically at the sides and near the foot of a mountain.

Beyond knowing what the animal looks like, and the type of country it is most likely to be found in, little else is known about this mountain will-o-the-wisp.

It might be assumed that its habits are much the same as those of the masked shrew or the smoky shrew, which are often found in the same rockpile. Fragments of spiders and centipedes have been identified from

stomach analysis, but they probably kill and eat a great variety of insects and other small invertebrates as well. Two females, trapped in May in northern Jefferson County, were each carrying 5 tiny embryos, not yet ready to be born. One female, captured in August, in the Adirondacks of New York, had two embryos. No one has seen their nest; no one has seen their young; no one has ever studied a living one.

How many of us realize as we tramp our Pennsylvania hills that there lives within them a four-legged animal that is unknown and unstudied as are the fish of the deepest seas.

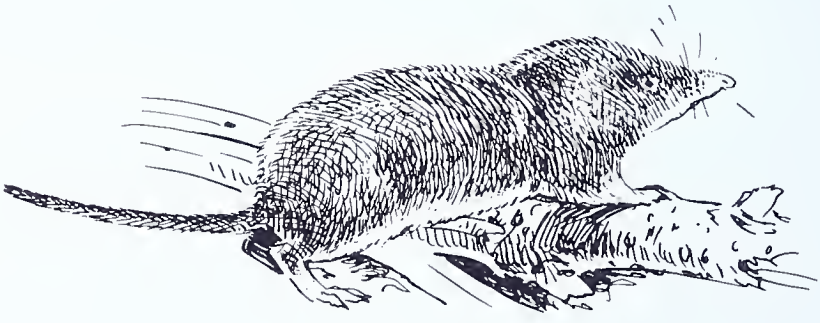
Subspecies in Pennsylvania: Sorex dispar dispar Batchelder

Range: In suitable habitat throughout the state except that it is absent from the extreme western and southeastern parts.

PYGMY SHREW — *Microsorex hoyi*

This shrew claims not only the distinction of being the smallest mammal in the Americas but also that of the State's rarest mammal. It is such a rarity, in fact, that no one has yet produced a complete Pennsylvania specimen. Evidence for the presence of *Microsorex* in the State lies solely in a fragmentary, but unmistakable, skull that was taken from the stomach of a red fox. The animal had been killed in Potter County by Robert Farwell during the 1949 trapping season and its carcass sent to the research laboratories of Carnegie Museum.

The pygmy shrew is closely related to the other species of long-tailed shrews. In the field it is indistinguishable from a small masked shrew. A typical specimen may be 3½ inches in total length, including the 1¼ inch tail. It weighs in the neighborhood of 2.5 to 3 grams—lighter than a hummingbird and approximately one-half the weight of a large earthworm! The animal can only be identified with certainty by the arrangement of the unicuspid teeth. The third unicuspid is so crowded in the tooth row that it is not visible without the aid of a magnifying glass.



PYGMY SHREW

Consequently the shrew appears to have only 3 small teeth between the large first tooth and the molars, whereas the other long-tailed shrews appear to have 4. Actually, they both have 5. The fifth unicuspid is very small, inconspicuous and lies nestled close to the base of the first molariform tooth. From a side view of the tooth row it cannot be seen.

For all of its scarcity, *Microsorex* has a wide range over North America. There is only one species, *hoyi* (in honor of P. R. Hoy, who collected the first specimen), which occurs from southern Alaska, throughout most of Canada to Labrador. In the United States it is found in the northern Rocky Mountains and the northern Plains states, east to New England and south to Virginia and Kentucky.

The habits and the habitat of this little shrew probably do not differ markedly from those of the other long-tailed shrews. The life history of the pygmy shrew has yet to be deciphered.

Why is the pygmy shrew so rare in collections, while the almost identical masked shrew is one of our commoner small mammals? Part of the answer may lie in the possibility that they have been caught but remained unrecognized or that they may have some peculiarity of habit which makes them less susceptible to trapping. Such was the case with the rock shrew, *Sorex dispar*. Once thought to be extremely rare, *dispar* is now turning up over the length and breadth of the Appalachians. When collectors learned that the elusive rock shrew lived deep between the boulders of mountain rockslides and that to capture them traps had to be placed deep in the crevices of the boulders, they began to take them in increasing numbers.

Whatever the answer is, the pygmy shrew appears to be a most uncommon mammal. Collectors should be on the alert for it. Any small, long-tailed shrew should be carefully checked with the thought in mind that it might be a member of this species.

Subspecies: Although the status in Pennsylvania is not definitely known, two subspecies *may* occur in the State: *Microsorex hoyi thompsoni* (Baird),

Range: western and northern Pennsylvania

Microsorex hoyi winnemana Preble

Range: May possibly occur in southeastern Pennsylvania.

SHORT-TAILED SHREW *Blarina brevicauda*

Other names: Mole shrew; bob-tailed shrew, big short-tailed shrew.

The short-tailed shrew is the largest and heaviest of the Pennsylvania shrews, measuring 4½ inches in length and weighing all of one-half ounce.

Shrews are closely related to the moles and the short-tailed shrew is often mistaken for its larger cousin. Its uniformly slate-gray to black

SHORT-TAILED SHREW

coat has the same velvet-textured, plush sheen; the eyes are minute; the ears are hidden in the fur and the pointed snout is tough and flexible. The nostrils open to the sides. The upper segments of the short limbs are included within the body contour. A short, one-inch tail, scantily haired, brings up the rear. The short-tailed shrew can be easily distinguished from all moles by the color of the teeth (chestnut-red in the shrew, white in the case of the moles) and their front paws, which are quite normal in size and not modified into the paddle-shaped, bulldozing forepaws of the moles. It may be confused with the least shrew, *Cryptotis parva,* the only other shrew in Pennsylvania with a *short* tail.

Blarina ranges throughout the eastern United States and southern Canada and is found in every county of Pennsylvania.

The top few inches of soil and leaf litter in almost any Pennsylvania woodland are riddled with a labyrinth of subsurface highways. This is the home of the short-tailed shrew. Although not as highly adapted for subterranean life as the moles, the shrews nevertheless burrow through the loose, friable soils of woods or gardens with a terrier-like frenzy, the tough snout constantly probing for food as it digs. It readily utilizes the burrow systems of other small mammals; also in areas where the ground is either too wet or too rocky for burrowing, it will make itself at home under any surface cover it can find. Although it does not invade

buildings as frequently as some mice do, this shrew is equally at home in a city lot or in wildest woodlands. Usually nocturnal in its movements, it is occasionally abroad during the daylight hours. In winter, when snow covers the ground it burrows through snow in a never-ending quest for food.

This is probably the commonest mammal in the State. Fortunately, its habits make it one of the most valuable to man. Each of these shrews will consume approximately its own weight in invertebrate life every day of the year. Any creature small enough to be overpowered is attacked. Its pincer-action front teeth and its poisonous saliva equip the short-tailed shrew for the carnivorous role it plays. Beetles, crickets, grasshoppers, bugs, insect eggs, cocoons, caterpillars, grubs, spiders, centipedes, millipedes, sowbugs, slugs, snails, carrion, all are avidly devoured.

This shrew occasionally dines on mice and other small vertebrates, sometimes rather extensively. Remains of meadow mice and jumping mice have been identified from short-tailed shrew stomachs. One observer, attracted to the scene by a mouse-sized commotion, observed a *Blarina* carrying a dying pine mouse, larger than itself. An analysis of droppings of a winter population of this shrew near Ithaca, New York, ran 56% mouse remains. Nests of this animal, composed entirely of mouse hair, have been found. Just how much of this represents carrion and how much of it represents kills by the shrew is not known.

Blarina is quite capable of dispatching a mouse twice its weight, but an adult mouse in the wild would have little difficulty avoiding a short-tailed shrew, unless cornered in a confining runway where its agility would be of little use. Nestling mice have no defense at all against a hungry shrew. There is little evidence that they are extensively preyed upon, however. Snails are a major article of diet. Caches of living snails, as well as heaps of discarded shells have been found in runways of this shrew. The snail is extracted from its shell, not through the natural opening, but through a hole which the shrew bites through the side of the whorl. Vegetable material is eaten sparingly. They are readily attracted to traps baited with peanut butter and captive specimens seem to thrive on canned dog food.

How much this shrew is aided by its poisonous saliva in subduing prey is not known. This poison has a decided effect on warm-blooded animals, affecting the nervous system. It produces a lowering of the blood pressure, paralysis and death when injected into laboratory animals. The shrew has no special adaptations for introducing the poison. It is merely mixed with the saliva, finding its way into a wound in very dilute amounts. The poison is produced by the submaxillary glands, located under the lower jaw. This is the only mammal, aside from the duck-billed platypus of Australia, that is definitely known to be poisonous. Several other species of shrews are under suspicion, however.

Blarina, voracious as it is in its grass roots world, is completely harmless and a decided asset to man. A short-tailed shrew will defend itself

in what must seem to it a most savage manner, if handled, but is rarely able to pierce one's skin. Perhaps it is just as well that it is so small!

Life for these insatiable little animals is a steady quest for food and more food. In proportion, a human would eat from 100 to 200 pounds of food a day. The smaller an animal is in size, the greater becomes the amount of body heat lost through radiation. In warm-blooded animals, which must maintain a constant body temperature, this presents a problem. If a small mammal is losing more heat proportionately than a large one, then it must produce more proportionately to maintain its body temperature. All shrews, *Blarina* included, have an exceptionally high metabolic rate. Both food and oxygen are consumed rapidly. The respiration rate of one captive animal, taken while it was asleep, was 140 per minute. Food passes completely through the digestive tract in approximately two hours and an enormous amount of it, from one-half to three times its own body weight is required daily. Death due to starvation can come in from one to two days time.

Often the pursuer finds himself, in turn, pursued. This shrew forms a steady item of diet for many of the larger predators. Short-tailed shrews have been found in the stomachs of opossums, weasels, mink, red and gray foxes, skunks, raccoons, bobcats, domestic cats, various species of hawks, owls, snakes, and even trout and sunfish. Its subterranean habits and its distasteful odor (faintly reminiscent of rotten eggs) may protect it to some extent. A captive weasel *(Mustela frenata)* is reported to have shown no qualms about killing and eating one. Domestic cats will kill them but will rarely eat them. The "baby mole" that the cat presents after a night of marauding will generally be this species.

The characteristic "shrew smell" emanates from three large skin glands, one on each flank and a central one on the belly. These are present in both sexes and are active throughout the year. They are most prominent on breeding males and least so on pregnant females. Their exact function is unknown. The odor may be left on the sides of the burrows and serve as a guide or a warning to other short-tailed shrews.

Blarina relies mainly upon its sense of smell and its ears in locating food. Whiskers on its probing snout and at each wrist aid it as it scurries through the leaf mold. The eyes can be located only by close inspection. They can do little more than register the presence or absence of light and are slightly smaller than the period that closes this sentence.

The nest, usually a hollow ball of unshredded leaves or dried grasses and varying in size from an apple to 6 or 7 inches in diameter, is most often located under old logs, rocks, old boards or other surface debris.

The private life of this animal, as is the case with most of our small native mammals, is almost unknown. It breeds from early spring until late fall. After a gestation period of about 21-22 days a litter of from 4 to 8 is born. Pink and helpless at birth, they grow very rapidly and are weaned and out on their own in from 2 to 3 weeks. "Baby" shrews

are rarely, if ever, seen except in a nest. By the time they leave the nest they are essentially adult in size. It is believed that females may have 2, 3, or more litters per year.

This great fecundity is balanced by a very high mortality rate. A short-tailed shrew rarely survives into its second winter.

This shrew may reach numbers estimated as high as 100 per acre. Numbers vary from year to year, however, and the same woodlot may be swarming with shrews one year and almost deserted by them the next. The reasons behind these periods of scarcity and abundance are largely unknown. They do not migrate but have a home range of a half acre at most, within which they spend their entire lives. The population turnover is so extremely rapid that one good or one bad breeding season may make a tremendous difference in their numbers.

Subspecies in Pennsylvania: Two as follows:

Blarina brevicauda kirtlandi Bole and Moulthrop

Range: Throughout most of the State except the northeastern corner.

Blarina brevicauda talpoides (Gapper)

Range: The northeastern corner of the State.

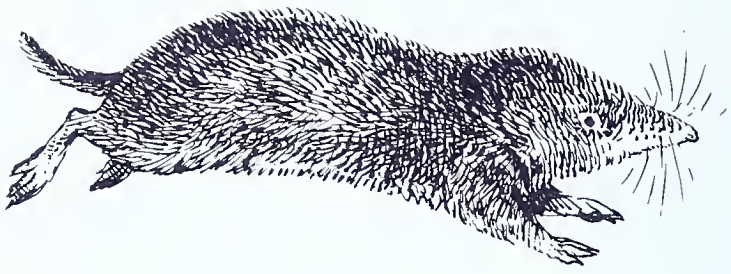
LEAST SHREW ***Cryptotis parva***

Other names: Little short-tailed shrew; field shrew; pygmy shrew.

On wide, soft wings, death beats over the night meadow. With a taloned swoop it drops to skewer the life from a squirming shrew. It rises again, to fly over moon-lit meadow and silent farmhouse to the silo, and glides to a perch. Inside a bobbing row of long-legged, half-grown barn owls eagerly awaits an evening meal.

Monkey-faced owls nightly patrol the meadowlands and the open fields, alert for the slightest sign of life below them. Any small creature of the night—mouse, mole, or shrew—is eagerly snapped up, and bolted, hair, hide, teeth, and all. In the stomach this food is subjected to the action of powerful enzymes. The digestible soft tissues are passed along to the intestines. The hair, the teeth, and the bones, however, remain unaltered. They are compacted into a pellet about the size of a ping pong ball and regurgitated. Owl roosts will be littered with these pellets. Each bears witness to the large number of small mammals, mostly mice, that this owl consumes annually.

Barn owls and least shrews have a curious connection. Large collections of barn owl pellets, when teased apart and the bones in them identified, will often contain skulls of this rare little shrew. In many cases, this may be the only indication the mammalogist has that this animal



LEAST SHREW

inhabits a certain area. It is seldom seen or collected by even the most ardent naturalists.

In appearance the least shrew is but a scaled-down model of the much larger, short-tailed shrew, the only other Pennsylvania shrew with a *short* tail. It is not far from being one of the smallest mammals on earth, measuring about 3 inches in total length, including ½ inch of tail. It averages about 4 grams in weight, or only 1/7 of an ounce, about one-fourth the weight of the short-tailed shrew. Apart from its diminutive size, and a brown rather than black cast to its dark, mole-like pelage, it is indistinguishable in the field from its larger cousin. *Cryptotis* can be positively identified only by examining its teeth with a magnifying glass.

Cryptotis is essentially a prairie shrew, much more at home in the grasslands of the Middle West and the South where it is not an uncommon animal. It is an inhabitant of meadows, old fields, dry, stony, abandoned pasturelands, hay fields and open country. But even in such places they are scattered in little local colonies and may be completely absent from what seems to be suitable habitat. Years ago, when Pennsylvania was a tree-covered wilderness, this shrew was either restricted to glades, river meadows and coastal swamps, or was absent altogether. The cutting of the forests and the cultivation of the land produced large areas of open country, into which this prairie-loving species could expand. *Cryptotis,* apparently, finds the cards stacked against it in our Pennsylvania hills, custom-built prairies notwithstanding, and remains one of the State's rarest small mammals.

However small it may seem, *Cryptotis* is a terror in its grass-roofed world. Insects, snails, worms, and other invertebrates are killed and devoured. This mite will consume its own weight in food daily. Like most small mammals its metabolism is exceedingly rapid. "Fuel requirements" are so demanding that, without food, it will starve to death in 24 hours. The least shrew is too small to be of much danger to a mouse, although captive specimens will eagerly devour the carcasses of dead

ones. In the wild they will pick up any carrion that presents itself. If a large earthworm is dropped into a cage with a least shrew—the battle is on. Little *Cryptotis* darts in like a mongoose, while the python earthworm writhes and struggles to crawl away, only to be brought up again by the shrew's hit-and-run tactics. *Cryptotis* has been suspected of having a poisonous bite, although this has not been proved to date.

Foxes and owls are known predators of this tiny mammal. The array of potential predators ready to snap up *Cryptotis* is an imposing one Only its high reproductive potential enables it to survive at all.

The least shrew has managed to keep its private life pretty much to itself, and very little is known of its reproductive habits in the wild. The breeding season is apparently a long one, however, as pregnant females have been taken as late as November 29 in the State.

The gestation period for this shrew is 21-23 days. The female may breed again immediately following the birth of her offspring, so that she may be furnishing milk for one hungry litter while the next is developing. The young (usually 4 to 6) grow fast. From a weight at birth of ½ gram apiece (3 grains of popcorn also weigh ½ gram) the young reach adult weight in about 3 weeks. Litters are weaned between the 18th and the 22nd day following birth at which time the harrassed mother is outweighed 3 to one. When you consider its high reproductive potentiality and its apparent rarity within the State's borders it seems rather obvious that this little shrew finds it tough going amid the complicated system of checks and balances that constitute its world.

The nest, a hollow ball of dried grasses, or leaves, is located beneath the ground or perhaps under an old board. Runways, each about the diameter of a large worm hole, wander haphazardly through the sod and the topsoil. At times they travel the surface paths of the meadow mice, much to the barn owls' satisfaction. They may also inhabit areas where the ground is too bare and stony to permit any burrowing. Here, *Cryptotis* must take advantage of any surface cover available.

Shrews, as a group, are relatively anti-social little killers. The least shrew seems to be an exception. Nests of this species containing 4 or 5 adults apparently living peacefully together have been found, and one winter nest was found to contain 12. Very little has been actually established about this shrews' habits. It is colonial, at least in Pennsylvania, and apt to be common within its widely scattered colonies.

Living as it does in fields, and preying on all types of insect life, *Cryptotis* is an efficient ally in man's efforts to control agricultural pests. Its rarity in the State, however, makes it of little actual value.

Subspecies in Pennsylvania: Cryptotis parva parva (Say)

Range: Probably throughout the State although specimens are lacking from large areas of northern central and southwestern parts of the State.

EASTERN MOLE

HAIRYTAIL MOLE

STAR-NOSED MOLE

HAIRY-TAILED MOLE ***Parascalops breweri***

Other names: Brewers mole.

Most of us are only dimly aware of the diverse kinds of small mammals that inhabit the State. To most, a bat is, first and foremost, something to hit a ball with, a shrew is a cantankerous woman, a weasel is an army vehicle, but a mole is—well, a mole. Everyone of us is familiar with these industrious little insectivores, at least by reputation if not at first hand. The hairy-tailed mole is a denizen of northern and western Pennsylvania.

Whoever coined the common name was as accurate as he was unromantic, for the hairy tail is the identifying characteristic of this mole. The hairy-tailed and the eastern mole resemble one another closely, and are, in fact, related species. The tail of the eastern mole is almost ridiculous—short, pink, and devoid of any but the scantiest covering of tiny hairs. *Parascalops,* on the other hand, while its tail is still relatively short, about 1½ inches, is identified by the dense brush of bristles that clothes it. The star-nosed mole, with its unique snout and long scaly

tail is in a class by itself and is not likely to be confused with either of the other two species, even though occurring in the same areas.

If you were to compare *Parascalops* directly with an eastern mole it would be somewhat smaller and lighter in weight. The fur would be slightly coarser and a more intense shade of black or brownish-black with silver highlights. Both species will often have patches of orange-tinted fur, especially around the throat, wrists and belly. This is not the natural color of the fur, but results from staining by secretions from skin glands. The grotesquely efficient forepaws of the hairy-tailed mole are somewhat smaller and not as broad in relation to their width. Both moles share the same body proportions. Both appear short-legged and rotund with about as much individual character as two furred bolognas. They appear eyeless, earless (moles can hear very well, however) and neckless. They are relatively helpless creatures on the surface of the ground, incapable of very little in the way of either flight or defense. But a mole is as much a creature of the soil as a bat is of the night skies, and it must be viewed in its element, the earth, to appreciate how efficient and wonderfully adapted it is.

Almost twice the size and three times the bulk of our largest native shrews (total length, 6 inches, weight about 50 grams) this mole and the short-tailed shrew are often confused. A shrew does, in fact, look like the popular conception of a "baby mole"—same pointed snout, hidden eyes and ears and dense plush pelage. A closer look brings out many basic differences between them, however. Shrews are semi-burrowing animals, but their forepaws are not noticeably enlarged. The paddle-shaped forepaws of the mole are very distinctive and the intense chestnut red color to the enamel of the teeth of the shrew will serve to distinguish it as well. The enamel of a mole's teeth is white. The young of most insectivores develop rapidly after birth and by the time they leave the nest they are essentially adult in size. So, unless a nest is accidentally discovered, the young are rarely seen.

The hairy-tailed mole, *Parascalops,* and the eastern mole do not occupy common ground in Pennsylvania. The former is absent from the Piedmont and Coastal Plain, as well as from the interior valleys of the Ridge and Valley Sector. *Parascalops* has never been taken east or south of the Blue Mountain, but is common enough in the Poconos, the north-central portion of the State, and the entire western one-half of Pennsylvania. In the south-central sector of the State this mole, in fact moles of any type, appear to find conditions less to their liking and are not as abundant as in other areas.

The life history of *Parascalops* essentially parallels that of the eastern mole. Most of its life, which may amount to 3 or 4 years, is spent beneath the soil, digging. From a nucleous of deep tunnels, the mole actively extends his domain up into the top few inches of forest duff or just under the sod. These familiar surface tunnels require a minimum of digging and are extended by a process not too unlike that of a man using

MOLE SURFACE TUNNELS are often a problem for the particular gardener. A mole's surface tunnels will create a strange pattern of lines in yard or flower patch. In winter, these activities are carried out deeper in the earth.

a breaststroke in the water. During the frost-free months of the year these shallow burrows are extended with happy abandon as their maker seeks out his prey. Some of these tunnels are used but once and then abandoned, others become trunk lines and get fairly constant usage, not only by moles, but also by such interlopers as mice and shrews.

The mole is fastidious in the maintenance and repair of these tunnels. If they are trampled down, or broken into he will repair the break, a trait which is used to advantage in the trapping of these animals. They will not ordinarily come to a baited trap but will generally burrow around it, as they will around any foreign object, and continue on their way. Moletraps set in runways that have been disturbed will usually catch the animals as they come to repair the damage. The tunnels of *Parascalops* are not as large in diameter as are those of the eastern mole but are conspicuous when they occur in a lawn or open field. In wooded land they are more often felt as the thinly roofed tunnels collapse underfoot.

In the winter when tunnelling activities are carried out deeper in the earth, or in the spring when females are busy excavating nest chambers "molehills," small piles of fresh soil, are thrown up onto the surface of the ground. The mole, like the lowly earthworm and the pocket gopher of the South and West does his share of soil conditioning, mixing, aerating, and loosening the soil inadvertently but efficiently.

In the early spring the reproductive urge may force the males out of the security of their subway systems in search of a mate. In late February and March the yearly reproductive cycle is in full swing and the young are born from a month to 6 weeks later. The exact duration of pregnancy is not known. Most births occur in April. The brood usually numbers about 4. They are born in a subterranean leaf lined nesting chamber.

This is excavated by the female and is connected by runways with both the deeper more permanent system and the shallow warm weather tunnels.

The mole is as active during the daylight hours as he is at night. The passage of night and day is all one to this miner and his periods of rest and activity seem to be quite irregular. *Parascalops* does come out onto the surface occasionally at night, however, and is often picked off by a prowling predator, a barn owl, a fox, or a tomcat.

Studies made of the daily food requirements of this animal vary widely, depending upon the animals' activities and the type of food they are eating. Experiments at the University of Massachusetts demonstrated that a hairy-tailed mole is capable of putting away three times its body weight in worms in one day's time. This seemingly high figure may be due to the rather low nutritive quality of a straight earthworm diet. Other studies have produced considerably lower figures. These animals consume large numbers of insects, both adults and larvae. Snails, spiders, centipedes, small vertebrates, in short, almost any type of living animal life that is large enough to eat and small enough to master, is eaten. Earthworms and possibly beetle larvae are the main attraction in the lawn. This mole consumes little or nothing in the way of plant life. The stomach of one hairy-tailed mole was found to contain two deer hairs. These may have been eaten accidentally or may indicate that the mole had been attracted to a deer carcass, possibly drawn by the accumulation of insects or by the carrion itself.

With the onset of cold weather the mole must follow its invertebrate prey beneath the frost line. It does not hibernate, however. What does it do and how are its activities affected by winter? It has been known to burrow through the snow and has been taken in all months of the year. Beyond this little is known of this animal's life history. Its burrow systems seem to be exceptionally busy places. How the mole reacts in the presence of the numerous mice, shrews and other moles that seem to share the same runways is not known.

Control measures for this species are the same as those employed against the eastern mole.

Subspecies in Pennsylvania: Parascalops breweri (Bachman)

Range: Western and northern parts of the State.

EASTERN MOLE — *Scalopus aquaticus*

Other names: Naked-tailed mole, common mole, short-tailed mole.

Despite the specific name *aquaticus* there is nowhere in Pennsylvania a more terrestrial "down to earth" mammal than the eastern or naked-tailed mole. This is the commonest and most widespread species of mole

in the eastern United States, occurring from coastal New England to Florida, west to the Great Plains, with but one major restriction—it avoids the mountains.

This is a mole of the coastal plain, the deep South, and the vast interior Mississippi valley lowlands. In the mountain and plateau country its place is taken over by the hairy-tailed mole, *Parascalops breweri.* The eastern mole is, therefore, completely absent from all but the southeastern quarter of Pennsylvania. This is the common lawn mole east and south of the Blue or First Mountain, which is the first of the parallel crests of the Appalachians. The animal has extended its range, in a few cases, westward into the mountain provinces by migrating through the watergaps, taking advantage of the alluvial soils of the river valleys. In this fashion it has been able to push up the Susquehanna river valley beyond Harrisburg to the mouth of the Juniata River at Amity Hall in Perry County. It has also been taken west of the Blue Mountain at Pine Grove along Swatara Creek in Schuylkill County.

Scalopus is more highly adapted for a strictly subterranean life than are either the hairy-tailed or the star-nosed moles. Identification is made easy by the combination of the large, heavily clawed, paddle-like front paws and the bare, flesh-colored one-inch tail. Internally this creature is a marvel of anatomical adaptations for the life of an animated bulldozer. Externally, however, it is about as graceful as a bean bag. All four limbs are included in the body contour, only the feet and the lower limb segments can be seen. The neck appears to be absent, and the apparently eyeless, earless head seems to be sitting directly between the shoulders. The forepaws are oriented so that the palms face to the side, a position as inefficient for walking as it is efficient for digging. The tubelike nose serves as a mobile, highly sensitive probe and is constantly in motion, sniffing and testing, during the mole's waking hours.

Despite his rather dumpy appearance the eastern mole has a most beautiful fur. Soft, dense, and durable, the pelage ranges in color from almost black with a glossy silver sheen to shades of gray and brown. Glandular skin secretions, at times impart tints of orange or gold to the fur of the ventral side of the mole. This fur has no definite "lay" to it but can be brushed almost as well forwards as backwards. The feet, the tail, and the areas surrounding the lips and nostrils are bare but all other parts of the animal are protected by this dense dirt-shedding pelage.

The eye no longer protrudes through the skin of the head but has been reduced to what looks like a small spot of black pigment lying under the skin. There are no external ears, the auditory canal opens directly onto the side of the head just above the front paws. Despite this seeming handicap moles hear well. They are especially sensitive to ground vibrations, as from a person's footfall.

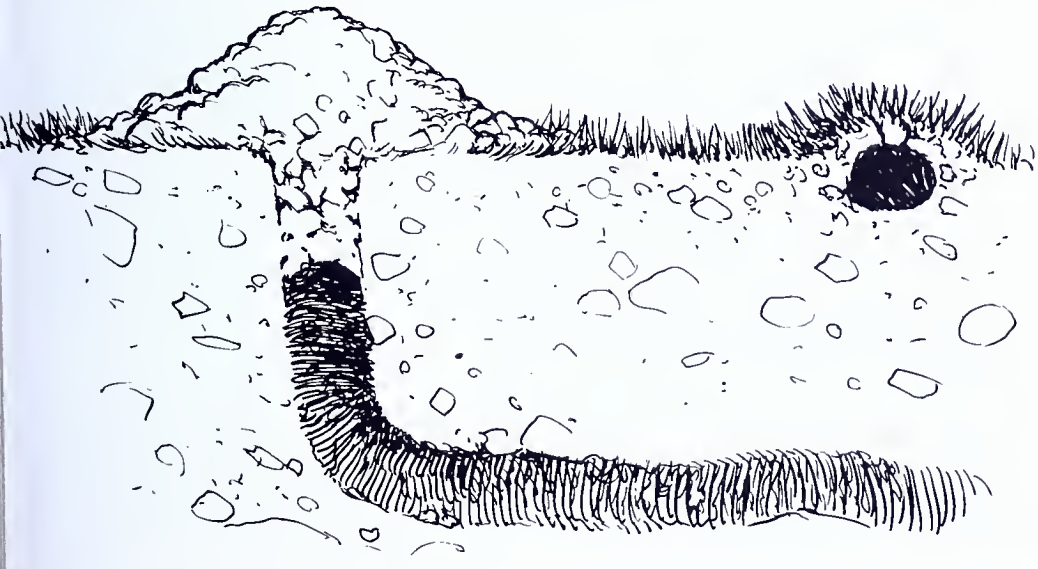
As moles go, the eastern mole is a good sized one. Adults measure 6 to 7 inches in total length and weigh approximately 1½ ounces.

The mole's world is underground and, as long as subterranean conditions are to his liking, this mammalian miner cares little about surface cover. He tunnels through forest, field and front lawn with equal ardor. Unlike the star-nosed mole, *Scalopus* avoids areas that are too wet and prefers well drained, friable alluvial soils. It is a powerful digger, however, and will often be found in quite gravelly situations if earthworms are found there. Lawns, golf courses, meadowlands and cemeteries are often riddled with their characteristic humpbacked tunnels and dotted with bare molehills which do so much to enhance a lawn or to dull a mower blade! Its hunting tunnels sometimes extend for hundreds of feet and appear to wander haphazardly about over the landscape. The shallow tunnels are connected with deeper permanent runways to which the mole retires during the winter months to continue there his quest for enough food to satisfy his colossal appetite. Some of these permanent burrow systems are kept in repair year after year and are used by succeeding generations of moles; others, especially the superficial shallow runways may be in use for a season or abandoned after one transit.

The surface tunnels are opened by the mole with a breast-stroke motion. Both forepaws are held in front of the snout then pulled back to the sides simultaneously. This may or may not be accompanied by a rocking motion. The sod is forced up in a ridge. As there is no excavated dirt to be disposed of, this is pretty soft going for the mole. In making deeper tunnels, where he can no longer force his way through, the mole resorts to actual digging, usually with scraping strokes of the great clawed paws. Loose dirt is periodically pushed out onto the surface to appear as "molehills."

Except during the mating season the eastern mole rarely ventures from his tunnel system, unless driven out by floodwaters. They are

IN THE SPRING, the females are busy excavating nest chambers. They create small piles of earth called "molehills" by pushing earth to the surface.



occasionally killed by dogs, cats or foxes, but possibly due to their odor are rarely eaten. Weasels and snakes are a potential menace but within the confines of their own tunnels, this mole has little to fear from predators. Changes in the physical environment are perhaps the mole's greatest concern. Floods and prolonged droughts may affect both the mole and his food supply. Despite these adversities, *Scalopus* leads a sheltered, comparatively secure existence in his subsurface haunts.

Secure he may be, but placid he is not. This little engine of destruction requires large amounts of high protein animal food and so tunnels at any hour of the day or night and at all seasons of the year, primarily for worms. Any small animal that it happens to encounter is killed and devoured—ants, beetles, snails and insect larvae of all types. It has been observed feeding on meadow mice and probably refuses little in the line of animal food that providence throws its way. This mole has been accused of dining upon vegetable material, and, apparently, it does so to a limited extent. The mole of the Pacific coast, *Scapanus,* does exhibit a decided liking for cultivated plants but our eastern mole is nothing but an incidental vegetarian. However, whether eaten or not, plants may be injured by the mechanical effects of the mole's plowing progress. The ridges of sod that it pushes up in the lawn often die, leaving a serpentine track of brown in an otherwise green lawn.

It is difficult to get a good quantitative estimate of the amount of daily food that the eastern mole must have in order to thrive. Feeding experiments made on captive specimens give an estimated 50% of its body weight as the daily requirement. These studies, while they do give some indication of the metabolic requirements of these energetic little mammals, are far from being the whole story. The amount of food which a mole will consume while confined in an enclosure and being fed on a diet which is not a completely natural one may be quite different from that required by a free living wild specimen.

Almost every aspect of this little mammal's daily and seasonal activities is insufficiently known. Their relations with other small mammals and with others of their own species is not known. Several moles may often be trapped in the same network of tunnels, and it is possible that the eastern mole may not be the solitary recluse it appears to be.

In the spring, usually late April or May, in a roughly constructed subterranean nest of dried leaves and grass, from 3 to 5 young are born. The gestation period is approximately 6 weeks and the young develop very rapidly after birth. Born pink and helpless they are weaned, almost reach adult size, and begin rooting for their own worms in a month's time.

One of the commonest questions asked about a mole is, "How can I get them out of the lawn"? They may be trapped, but require a specially designed trap. They may be discouraged by placing mothballs or lye in their runways. They may be caught in the act of extending their

surface tunnels across the lawn and flipped out if you're quick enough with a shovel. In suburban lawns they are rarely a cause for concern but in golf courses, cemeteries, seed beds, and similar places, they are of considerable nuisance value. A booklet, "Mole Control," by James Silver and A. W. Moore is available from the Superintendent of Documents, Washington, D. C. It discusses at length the various methods of controlling these animals.

Although moles are almost exclusively carnivorous and consume quantities of injurious insects and their larvae, their desirability from an economic point of view has often been exaggerated. Their principal food, the earthworm, is of some value in helping to maintain the health of the soil. The worm's burrowing activities promote the formation of humus in the soil. They help to aerate the ground by loosening it, thereby increasing its ability to retain rainwater (earthworm plowing). To a certain extent, the mole does this as well. But mole tunnels sometimes serve as nuclei for gully erosion. On the other hand, the mole, for all of his energy and bulldozing thoroughness makes a very small dent in the total earthworm population. Moles may consume a great many of them but do not control their numbers (nor the numbers of cutworms, or Japanese beetles larvae except locally). On the other hand, the distribution and numbers of moles is controlled by the available food.

The moles represent the end product of an adaptive line of evolution extending back many millions of years. From a basic stock of insectivores, not too different in external appearance from the present day shrews, the moles have become so perfectly adapted to their own specialized way of existence that they represent somewhat of an incongruity, a highly specialized member of a highly primitive group of mammals.

Subspecies in Pennsylvania: Scalopus aquaticus aquaticus (Linnaeus)

Type Locality: Eastern United States (Philadelphia, Pennsylvania.)

Range: Southeastern part of the State.

STAR-NOSED MOLE — *Condylura cristata*

Other names: Long-tailed mole, swamp mole.

This animal is unmistakable—from either end. It is the only mole to be found in the Eastern United States with a long tail, and the only animal in the world with a star-nose.

The nose is decidedly pig-like, and not at all like the pointed probes of the hairy-tailed mole or the eastern mole. The end of this snout is surrounded by a circle of short, pink tentacles, giving a sun-burst effect to the organ, as if its owner had a close call with a meat grinder. These tentacles, 11 on each side, are richly supplied with tactile nerve endings and are sensitive to touch. They have no independent movement of

their own, but can be moved as a unit, pointed forwards or backwards at will. They are constantly being brought into play as the mole probes and tests with its ornate but highly sensitive snout.

Except for the prominent pink of the snout, the star-nosed mole's chunky, 5-inch body is covered with a dense, soft coat of black fur. The rat-like 3-inch tail is dark, scaly in appearance, and thinly covered with short, black bristles.

This mole is not as extremely modified for life underground as are the other two species. Even so, it is obviously a mole. All four feet are enlarged, the front pair especially so. Because of a foreshortening of the neck and of the entire shoulder architecture for greater mechanical

STAR-NOSED MOLE is unmistakable. It is the only animal in the world with a star-nose and the only mole in Eastern United States with a long tail.

efficiency in digging, the front paws seem to sprout from the sides of the head. These paws are scoop-shaped, shortened from front to back and widened from side to side. Internally they form a powerfully knit structure of short, massive bones and powerful tendons. There are 5 toes, each extremely stubby but provided with a heavy, nail-like claw which is actually longer than the toe itself. The hind feet are more normal in appearance but are relatively larger than are those of other moles. The skin of both fore and hind feet has a primitive scaly or pebbly effect to it.

This animal is remarkably well provided with structures which are sensitive to touch. In addition to nose tentacles, long whiskers on the side of the snout, and a few at the sides of the eye and the ear, this mole has whiskers on his front feet. The margins of the palms are edged with a row of whiskers of varying lengths.

In contrast to this, the eye and the outer ear have been reduced, although not quite as drastically as in the other moles. The eye, complete with eyelids, black, bright, but only 1/50 of an inch in diameter, lies deeply buried in the fur of the head, slightly above and behind the corner of the mouth. Its eyes are capable of little more than registering the presence or absence of light. The external ear has disappeared almost completely but under the protecting hair the organs of hearing and the auditory canal are large. They are relatively much larger than our own. The eye has atrophied not so much because the mole operates in the dark but because a mole's tunnel is no larger than the animal itself. Under these conditions the best eye in the world would be useless. It would, in fact, be a decided detriment. Can you imagine a mole that got dirt in his eye! All external parts which might be dirt catchers have been eliminated during the course of the mole's evolution and the eye and ear openings covered with dirt-shedding hair.

The long tail, unusual among moles, swells enormously during the winter months, in most, but not all individuals. Actually, specimens with enlarged tails have been taken from October through June. Ordinarily the tail is rat-like in appearance. As it commences to swell the base remains the same in size and so appears to be restricted as the tail fills out 3 or 4 times in diameter. This swelling is greatest about 1/3 of the way along its length. From there it tapers gradually toward the tip. This enlarged tail is somewhat of an enigma. One is tempted to think of this as a reserve source of energy, somewhat similar to a camel's hump or the thick rolls of fat on an autumn bear. The animal is active all year round and does not hibernate. And why do not all winter-caught specimens have swollen tails? The stored material is excessively greasy and will be rapidly resorbed if a star-nosed mole is held in captivity for a few days.

Condylura is statewide in distribution and may be expected wherever suitable habitat occurs. It becomes rather scarce in the southwestern corner of the State. Star-nose moles have been reported from every county in that sector, however, with the exception of Greene County.

This is not the ordinary "garden variety" mole. The star-nosed mole prefers a swampy terrain. It rarely extends its tunnelings out into lawns, unless a lawn happens to be poorly drained. The best places to search for signs of this mole are wherever conditions are such that the ground is wet or swampy at least for a part of the year. It is tolerant of a variety of soil types, but is most common in areas of deep loam that occur near stream courses, or in the black, saturated muck of a lake margin or a cattail swamp. Now and again, which should prove to us that the factors involved in the relationship between an animal and its environment are complex and not always susceptible to glib definition, this mole will be found living far from the nearest water. It has been taken on the driest of mountain ridges, apparently burrowing through pure sand. This is decidedly the exception however.

At first thought, the idea of an aquatic mole is as incongruous as that of a flying elephant. The star-nosed mole swims and dives with ease. Some individuals, at least, spend a large share of their time under water. They have been seen swimming under the ice in wintertime and are occasionally caught in muskrat sets, much to the trapper's disgust. Its runways appear to wander through the saturated soils with little regard to the water level and often dip beneath it. These moles have been caught by sinking a rat trap across a completely water-filled mole tunnel. This is the only species of our moles, incidentally, that can be caught by a judiciously placed snap trap. The others are notoriously trap shy and will burrow under or around any traps placed in their runways. There are especially designed mole traps on the market, however, for the "smart ones."

Although it does come up to the surface at times and may undertake long overland journeys especially during dry spells, this mole, like all moles, is a miner. Molehills often mark the course of his deeper tunnelings. Surface tunneling, in which the earth or the sod is merely pushed up into an arch as the mole progresses, leaves the familiar tell-tale surface ridges but no excavated earth to be disposed of. During the winter months when moles must burrow below the frost line, or while excavating permanent tunnels deeper in the soil they push the excavated dirt up to the surface and out of their tunnel system. All three species of moles occasionally throw up molehills of raw earth. Crayfish burrowing in swampy areas will also build up chimney-like mounds of mud somewhat similar to the workings of the star-nosed mole. The crayfish, however, will leave a large opening in the top of his chimney which leads straight down into his tunnel system. Mole runs are never open to the surface unless they are old abandoned ones, or are broken into accidentally, in which case the mole will speedily repair the break. Molehills are built up by a sort of volcanic eruption. The animal itself never carries the dirt out onto the surface but forces it up from deep in the tunnel. Hence there is never the central hole so characteristic of the crayfish.

Moles expend a great amount of energy as they plow their way through the soil in search of food, and they require a great deal of it to keep going. Various estimates as to their minimum daily food requirements, ranging from 25% to 100% of their body weight have been made. So few studies have been made upon living moles, however, that it is not possible to be too definite on the subject. We do know that moles require large amounts of animal food, and will speedily starve to death in a few days without it. Strictly carnivorous, the star-nosed mole consumes great quantities of invertebrate life. Earthworms form the bulk of the diet, which varies somewhat with the individual, depending upon whether it is living in an aquatic or a terrestrial situation. Aside from worms, the menu is made up of whatever small animal life the mole happens to encounter—beetles, ants, grubs, other insect larvae, slugs, and possibly small vertebrates such as salamanders, young snakes, or nestling mice.

Moles spend more time on the surface of the ground than is commonly suspected and it is not unusual for *Condylura* to fall prey to a fox, a house cat, or a marauding owl. Snakes are a potential danger as well as weasels. Swimming individuals may be picked off by large fish. In low lying areas, floods may kill a great many, especially the nestlings. When this animal remains underground, however, few predators can reach him. All in all, the star-nosed mole leads a comparatively sheltered life, unbeset upon by the army of tooth and claw that awaits most other small mammals.

Moles do not breed at the feverish rate of the surface-living shrews and mice. There is some evidence that star-nosed moles may live in pairs during the winter, the males leaving in the spring with the birth of the young. The gestation period is unknown. Three to 5 young are born in a crude subterranean globular nest of rotten leaves or grass usually in late April or May. Pregnant females have been taken as early as April 13 and as late as July 23 in Pennsylvania.

The young, even though born pink, hairless and helpless, are easily recognizable by the nose tentacles. Gardening time for man and baby time for moles happens to coincide and nests of this species containing young are occasionally unearthed accidentally in manure piles or compost heaps. Moles seem to be attracted to such places by the large numbers of worms to be had. In a month's time the nest is deserted, as the young grow at a great rate, and they are soon able to dig for their own dinners.

Star-nosed moles are not rare but, like most species of animals, they occupy a definite ecological niche. That of *Condylura* rarely overlaps man's domain and we get the impression that this is a most uncommon animal. In some areas its density has been estimated at 5 pairs per acre.

This mole is of little economic concern and usually inhabits areas that are submarginal as far as man's activities in general are concerned.

Subspecies in Pennsylvania: Condylura cristata cristata (Linnaeus.)

Range: Throughout the State, except that it is apparently absent from a small section in the southwestern corner.

EVENING BATS

Family VESPERTILIONIDAE

A bat is like no other mammal. To watch one swoop and dart in the twilight sky, rivaling the swallows at their game, does little to suggest that its closest living relatives are the burrowing, ground-loving moles and shrews.

Fossil remains of bats, surprisingly modern in appearance, are known from the early Tertiary Era, 50 million years ago. They tell us little of the evolution of the bat as a flying machine, or of its immediate ancestry, but do point up the fact that the bats evolved very early in the Age of Mammals, and have proved to be one of the most successful and long-lived orders of the class Mammalia.

Most of the bizarre and curious modifications of the bats are, either directly or indirectly, adaptations to meet the physical demands of flight. Stripped of these, they retain many basic and primitive characters which relate them to the Insectivores.

The outstanding feature of a bat is, of course, his ability to fly. Gliding is fairly commonplace—there are two flying squirrels in Penn's Woods which are experts at it. But the bat alone, of all mammals, flies and this aerial way of life has left its stamp on almost every feature of its anatomy. Arms and fingers have become tubular and riblike to support the delicate flight membranes.

All four fingers form the frame of the wing, each finger enormously elongated to form an umbrella-like strut in the extended wing. The flight membranes of the bat are of living skin, pliable, elastic, but also thin and easily torn. They extend from the tips of the 'fingers' to the ankle, and, in the evening bats, which include all of our Pennsylvania species, an additional membrane stretches from the leg to attach along the entire length of the tail. This interfemoral membrane has a multitude of uses—as a rudder, a handy backstop against which to catch insects, a basket that comes in handy during the birth of a young bat, or, in the case of some of the migratory bats, as a blanket of sorts. An additional web of skin, the antibrachial, extends from shoulder to wrist on the leading edge of the wing. The only sections of the bat's body that project from the flying membranes are the head, the clawed "thumbs," and the gaff-like feet.

The power to propel this well-equipped flier comes from powerful chest muscles. The bat's ribcage, collarbones, shoulderblades and breastbone are almost grotesquely overdeveloped to provide attachment for the heavy flight muscles, as well as to serve as levers against which these muscles operate to send the bat into the air. The pectoral muscles,

NED SMITH

which provide the powerstroke, pulling the wings downward, are the largest muscles in the bat's body. The hindquarters of the animal, by way of contrast, are weakly developed, the spidery hindlegs incapable of supporting the weight of the animal in what we have come to consider a normal fashion. In between flights the bat will usually be found hanging head downward, suspended by the sharply curved hind claws, which catch and hold on the slightest irregularity. This position requires no muscular exertion on the bat's part. He merely dangles free. When first alighting, or when scuttling about looking for just the "right spot" to hang up in, the bat may drag himself about by his clawed thumbs, the body slightly raised, looking for all the world like some furred crab. Some species can progress quite rapidly in this awkward fashion.

All bats fly, and are built along the same anatomical outlines. They differ from one another in those characters not directly involved in flight—dentition, color and size and shape of ears.

Pennsylvania's 11 species of bats are members of a single family—Vespertilionidae—the evening bats.

The evening bats are found throughout the world, a very large family of small, insect-eating bats that range from the tropics to the subpolar regions In some respects, they are the most specialized of all of the bats. They possess a generous mouthful of sharp needle-cusped teeth which are well suited for an insectivorous diet. The tooth formula varies from genus to genus within the family and the number and position of the teeth can be used to identify some individual species of bats.

"As blind as a bat" is not the handicap that at first glance it seems to be. In the first place no normal bat is blind. But the eyes of most of them are greatly reduced in size, no larger in many cases than the head of a pin. Why? Most of the other creatures of the night, those that hunt under conditions of very faint illumination, have large, well-developed eyes, to gather as much light as possible. Bats, of all creatures, would seem to require keen eyesight to pursue tiny flying insects in the twilight sky. Early naturalists soon discovered that a blinded bat seemingly was not handicapped in the slightest but was rendered almost helpless when its ears were blocked so that it could not hear. Deafened bats were reluctant to fly and would crash into objects placed in their path. Normally these animals have an amazing ability to avoid any object during flight, from a thin strand of wire to the rock walls of a cave. It was also established that a bat's flying efficiency was greatly reduced when its mouth was sealed. Early anatomists were impressed with the size and construction of the bat's larynx and vocal cords. But there the matter stood for several hundred years. It was quite obvious that bats made no sustained sounds during flight. All one had to do to prove this was to listen. The most plausible explanation for obstacle avoidance seemed to be that the bat somehow "felt" the approaching object, perhaps by variations in air pressure. This was before the age of supersonics, or of the modern recording devices of the acoustic laboratory.

It is now known that bats do produce sounds during flight, supersonic sounds pitched far above the limited capacity of the human ear. Humans hear aerial vibrations as low as 16 per second and usually no higher than 20,000 per second. Anything lower is felt rather than heard; any sound higher just doesn't register with us. A dog is able to hear sounds with a frequency of up to 35,000 per second, hence the

LITTLE BROWN BATS in hibernation in Milroy Cave in Central Pennsylvania. They begin hibernation in late October or early November. Clusters on cave walls may contain as many as a hundred bats.

success of the "silent" dog whistle. Bats can and do emit audible cries when excited, but during flight emit machine-gun-like bursts of supersonic sound that range in frequency from 40,000 to 100,000 vibrations per second. The strongest of these lie at about 50,000 vibrations per second. These cries have a duration of only 2/100 of a second and are emitted at varying rates, from 5 to 10 per second while the bat is at rest, increasing as the bat approaches an object to about 20 to 30 per second. The sound waves radiate out in all directions. If they strike an object an echo wave returns to the bat's ear where it is interpreted. The closer the object the quicker the echo returns, and the stronger it is. At very close range, 2 feet or less from any object, this system ceases to operate, the "echo interval" becoming so short that the echo is back before the sound is completed. Utilizing and developing this "sixth sense," bats have been able to exploit a unique environmental niche, where, almost free from enemies or competitors they sweep the skies for insects.

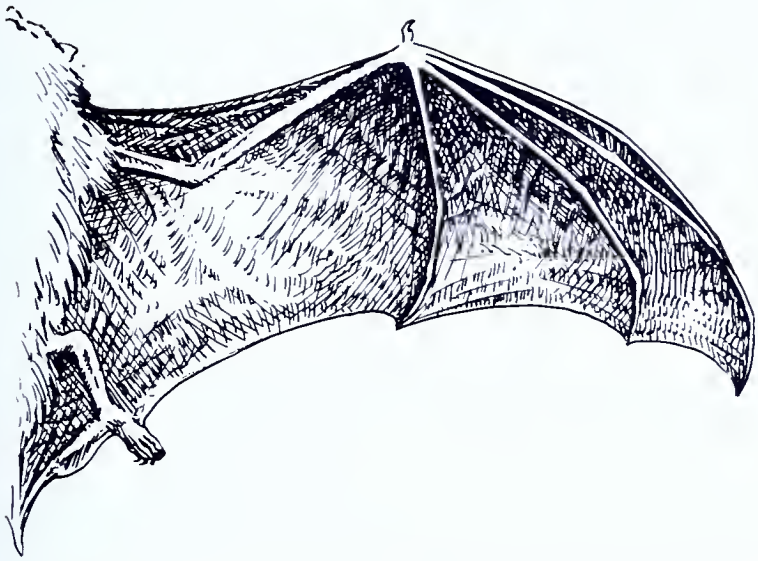
Apparently echolocation has been substituted for eyesight. And the reason most probably lies in the optical limits of the vertebrate eye. To

be of any use at all in night vision the eye must be large, and to be aerodynamically successful the bat must remain small. Perhaps, if flying insects were larger, their capture "by eye" would have been practical, but under the conditions that bats hunt, the eye to be of any critical use to its owner would have to be of prohibitive size. One eyeball of a great horned owl, another night hunter, is as large as the entire body of most bats. Echolocation, as used by the bat is a very delicate and efficient sense supplanting to a large degree sight and smell, the senses that are used by most other groups of predators.

In Pennsylvania during winter, the bat has two alternatives if he is not to starve. He must either head south or take refuge where killing temperatures of winter are modified and there wait for spring. Three Pennsylvania bats migrate south for the winter. The remainder hibernate, usually in caves.

Bats are true hibernators. The bear, the skunk, and the raccoon bed down in great rolls of fat and may fast and sleep for long periods. But they never reach the deep, helpless, death-like state of the woodchuck, the jumping mouse or bats in winter. During this period bats eat nothing but slowly burn their fat reserves. Some species go into hibernation like winged butterballs. The body temperature is lowered until it approaches that of the animal's surroundings. Respiration and heartbeat slow up. The blood changes in composition, large numbers of blood cells being stored in the spleen of the hibernating animals. Bats apparently wake occasionally during their hibernation and some movement from place to place within the cave may take place. They are only moderately hard to arouse from hibernation and will often revive enough to take flight in from 10 to 15 minutes if handled. Some species hibernate from 6 to 7 months of the year, others only 4 to 5.

Bats appear to be unable to maintain a high internal temperature as the temperature of their surroundings drops. In this respect they appear almost cold-blooded. Possibly this is a reflection of the fact that bats are essentially tropical animals, relatively ill-equipped for the cold. This strange attribute of our northern bats lapsing into a comatose state during those periods when they are inactive, or during cold snaps has distinct survival value. Normally the bat requires tremendous amounts of food to provide the energy required by an aerial mode of life. When insects are not available it is imperative that these animals have some method of conserving energy and cutting down on fuel requirements, lest they speedily starve to death. This they do by lapsing into a deep sleep highly suggestive of hibernation. Whether or not this ability to bank life's fires is under the conscious control of the animal itself is not known. Bats, despite their small size and their high metabolic rates, are notoriously long-lived, up to at least 19 years in some species. Even the delicately constructed pipistrelle, the pygmy bat, has been known to have lived for 7 years.



THE OUTSTANDING feoture of the bot is its obility to fly. All four fingers form the frome of the wing, eoch finger enormously elongoted to form on umbrello-like strut in the extended wing.

Bats, contrary to common belief, do not make a practice of enmeshing themselves in women's hair, nor are they crawling with lice. Despite all of their netherworld qualifications, bats are cleanly animals, taking great pains with their toilet, going over their fur and flight membranes with the fierce fastidiousness of a fireside tabby. In common with all other mammals, they may carry parasites both external as well as internal, but are by no means crawling with them.

Rabies in bats, carried principally by the blood-feeding vampire bats, has become a serious menace in tropical America. Rabies has been authoritatively reported from several species of bats in Pennsylvania. This is not a signal for a mass campaign to wipe out the bats in their winter quarters, however. It is difficult to see how rabies could be passed on to our small insectivorous bats. The rabies virus can survive only in warm-blooded animals and is as lethal to bats as it is to men or dogs. The best explanation is that migratory bats somehow acquired rabies, probably from bites of other rabid bats while in their southern wintering grounds and thus carried the disease northward. One definite record of a rabid bat in the State is from a migratory species, the hoary bat. Rabies has broken out from time to time in other wild mammals such as foxes and skunks. Any warm-blooded animal is susceptible to the disease in one form or another. Rabies in bats, in the small insect-eating species of the northern United States, fortunately is not common.

Strange little animals about which much more remains to be learned, bats are common in the caves and the summertime sunset skies of Penn's Woods.

LITTLE BROWN BAT — *Myotis lucifugus*

Other names: Little brown myotis; LeConte's bat.

This is our commonest bat. Literally thousands of little brown bats spend the winter in Pennsylvania's caves where they hibernate in spectacular concentrations. During the warmer months of the year they forsake the caves and spread out over the countryside to settle in barns, deserted buildings, attics, in hollow trees, behind shutters, yes, and even in belfries. Large nursery colonies of this species return year after year to establish maternity wards on the same rafters and to hunt the night skies along the same woods and water courses.

The wings and other flight membranes of this bat are black and bare, but the round body is densely furred. Dorsally the little brown bat is a dark walnut brown, ventrally a dull buff. Occasional individuals are much brighter on the back, the fur washed with a golden tint which might remind one of a lion's mane. Younger (but not necessarily smaller) bats are blacker and duller in tone than are the adults. The individual hairs are soft and rather limp, producing a pelage with no definite direction to it. Only the terminal third of each hair is colored; the rest of the shaft is a dull black.

Although it has a wingspan of some 10 inches, the body of this bat measures only 2¼ inches from nose to rump. The tail, completely enclosed in the interfemoral membranes, adds an additional 2 inches to the total length. The face is well furred, the eyes reduced in size but functional and the ears are well developed and about the same relative size as a mouse's (*Myotis,* L. "mouse-eared"). They are naked, blackish brown, and slightly longer than they are wide. From notch to tip the ear measures 15 mm., the tragus 8 mm. The tragus, an erect slender cartilaginous process that arises from the notch of the ear and extends upward and parallel with it, is thought to function as an integral part of the bat's echolocation mechanism. When the ears are pressed forward, they just barely reach the tip of the nose, a character which will distinguish *M. lucifugus* from the very similar but longer eared *M. keenii.* The long-eared bat's ears will meet at a point slightly beyond the end of the snout.

Two additional species of bats of the genus *Myotis* occur in Pennsylvania. Leib's bat, *M. subulatus,* and the Indiana bat, *M. sodalis,* are almost identical in appearance with the little brown bat. Leib's bat, a rare species, is slightly smaller. The Indiana bat has a peculiar pink cast to the fur. Unless one is thoroughly familiar with bats, these species cannot be differentiated one from another in the field. Accurate identification depends upon cranial as well as external characters. Questionable specimens should be submitted to a bat expert (and there are such people!).

Sometime near dusk, the exact time varying with weather conditions and the length of day, the little brown bat launches itself for the evening

hunt. On fluttering wings it darts and turns through the clouds of flying night insects, grasping them between needle-sharp teeth. Bats shot within an hour after they have begun their evening flight very often have a full stomach, the contents of which may weigh one-fifth as much as the bat itself. This makes it probable that the bat does not hunt throughout the night but restricts its activities to an evening and possibly a dawn flight. Bats require a reliable source of water. In captivity, the little brown bat will lap water from a dish like a dog, but in the wild has been seen to dip to the surface of a pond or a stream and drink on the wing.

A great variety of small flying insects, beetles, flies, mosquitoes, bugs and moths fall prey to the darting bat. Caged little brown bats will learn to eat meal worms (*Tenebrio* larvae) when offered to them by forceps, but most, if not all, of the food of the little brown bat in the wild is acquired on the wing.

About August the little brown bat begins to get noticeably fatter and by October the animal has accumulated extensive rolls of subcutaneous fat. In the spring, adult specimens average 4½ to 5 grams in weight, but by October they will average 8 to 8½ grams. This food reserve will be used up during the long winter fast which lies ahead. In October, or sometimes as late as early November, the bats, well fed and ready for hibernation, gather in caves or occasionally in mine shafts or abandoned tunnels. Deep underground, the temperature never reaches freezing, no matter how severe the winter. Cave temperatures in Pennsylvania average about 48° F. throughout the year. Here, suspended from the walls and ceilings, large numbers of bats press against one another as tightly as sardines in a can. These clusters may contain upwards of a hundred hibernating bats. As they hang, their metabolic activity slows up—body temperature drops, respiration and heartbeat slow to a bare minimum, the amount and the composition of the blood is altered, the spleen becomes greatly engorged, and bodily motions slow up and finally cease altogether as the bat relapses into a deep, comatose sleep.

Bats will return to the same hibernation sites year after year and often show remarkable tenacity about such matters. The tunnels for the Pennsylvania Turnpike were started in 1883 for a railroad which never materialized—the South Penn Railroad. They were abandoned, half finished, in 1885 and through the years acquired large populations of cave bats. In 1939 the tunnels were to become a part of the present turnpike system and work was begun to complete them. At that time there were in the Kittatinny Mountain east tunnel an estimated 3200 little brown bats trying to get to sleep. Charles E. Mohr found them going into hibernation while blasting and tunneling were in progress. He marked and transported 2500 bats of three species, the little brown bat, the Indiana bat and the pipistrelle, to Aitkin cave in Mifflin County, a distance of 80 miles, but apparently the transplanting didn't take. Mohr was never able to retake any of the marked, transplanted bats in

THE POWER TO PROPEL this well-equipped flier comes from powerful chest muscles. The bat's ribcage, collarbones, shoulderblades and breastbone are almost grotesquely overdeveloped. These are little brown bats in flight.

Aitkin cave, nor was he able to note an increase in the number of bats which hibernated there. During the fall of 1940 many bewildered bats were reported flying through the completed turnpike tunnels. There are no bats in the tunnels today. Another of Mohr's experiments, which points up the bat's tenacity in choice of a home site, involved a summer colony of over 200 little brown bats that occupied an old house. Collecting the entire colony, he moved them 12 miles to another old house which seemed to him to be just as dilapidated. The bats apparently thought otherwise. Overnight the entire colony, save for one injured member who was abandoned, flew back to the original roost.

As spring arrives with its congenial temperatures and renewed food supplies, the bat, probably responding to some inner physiological clock, wakes up and sallies forth. The males scatter throughout the countryside and apparently lead bachelor lives throughout the summer. Mating takes place in the fall, occasionally during the winter months or possibly in early spring.

Regardless of when the female is mated, her ovaries do not become active until April, at which time a single egg is shed and fertilized. Viable spermatozoa may survive the winter months, stored in the reproductive tract of the female. The females, upon leaving hibernation, gather into summer nursery colonies where the young, usually a single, are born during June or early July. One such maternity ward, located on the campus of the University of Southern Illinois, held an estimated 30,000 bats.

The young weigh about 1.5 grams at birth, about one-fifth the weight of the mother. Born black, wrinkled and unable to fly, the young remain clinging to the roosts during the mothers' nightly forays. Nourished by milk from the mother's two pectoral mammae, they grow rapidly. In 4 weeks' time the young bat is full size and ready to strike out on its own.

Hibernating populations of this bat invariably show a predominance of males, ranging from 56 to 70 percent. Summer colonies, on the other hand are composed almost exclusively of adult females plus their young. Some summer colonies apparently do contain a small percentage of males; the bulk of them, however, are scattered over the countryside, leading solitary lives.

Bats are notoriously long-lived creatures, despite their extremely high metabolic rate. But when you consider that for half of every year they are coasting along in neutral, in the deep sleep of hibernation, and that most relapse into a comatose sleep from dawn till dusk of those days when they are active, it seems a wonder that they ever wear out! Authentic cases are known of little brown bats 19 and 20 years of age. These are based upon the recovery of banded wild bats. One female of this species had young when she had reached a known age of at least 12 years.

These bats have comparatively few enemies. Occasionally a barn owl will catch one, or through a fortunate set of circumstances, a cat or some other four-footed predator will blunder into one. They are most vulnerable during hibernation when they can be scooped off cave walls literally by the hundreds. Even at this helpless stage of their annual cycle they are rarely molested, due to the inaccessible sites in which they hibernate. Probably their greatest enemy is the amateur caver. Through the efforts of many conservationists and scientists, and especially of such groups as the National Speleological Society, however, cavers are realizing the uniqueness of these flying mammals and the importance of preserving these creatures in their cave habitats. These bats have an extremely low reproductive rate compared with most other small mammals, and in the face of wholesale raids upon their hibernating grounds would not be able to sustain their numbers for very long.

The little brown bat is of little economic importance. Although they do eat vast quantities of insects, they make little headway toward an actual reduction in insect numbers. The accumulated droppings and the strong odor of a large summer colony of little brown bats often makes them objectionable neighbors. The only effective way of bat-proofing a premise is by blocking up every possible avenue of ingress to an attic, every crack, every knothole, during a time of the year when the bats are not in possession. As a bat can crawl through so many inaccessible cracks and is so persistent in its efforts to re-enter a roost, boarding it up is usually easier said than done. Moth balls or flakes of paradichlorobenzine sprinkled about the roost will discourage them temporarily.

The little brown bat ranges over most of the United States and Canada. It does not occur in the southeastern United States, but in our area it is the most common species.

Subspecies in Pennsylvania: Myotis lucifugus lucifugus (Le Conte)

Range: Throughout the State during the summer months, but is restricted in the winter to Pennsylvania's caves.

KEEN BAT — *Myotis keenii*

Other names: Say's bat, Trouessart's bat; eastern long-eared bat; acadian bat.

This is one of the more uncommon cave bats. In size and coloration it is virtually indistinguishable from the little brown bat *(Myotis lucifugus)* and more often than not will be found hibernating with that species. But it can be recognized by its longer ears and larger, sharply pointed, erect tragus. There are numerous technical points of difference that characterize this species, but the ear is the best and simplest field character. If the ears of *Myotis keenii* are laid forward they will meet at a point about one-sixth of an inch beyond the end of the nose. In the

other species of Pennsylvania cave bats, the ears will just barely reach the end of the nose when pressed forward. The length of the ears of the Keen bat and the little brown bat differ by only a matter of a few millimeters, but the difference is very consistent. When the two species are directly compared, the difference is very apparent—*Myotis keenii* looking a bit mulish.

This is a sociable species, gathering in small summer colonies. They are more often encountered in the summer months than they are in their winter quarters—the reverse of the usual situation among cave bats. The Keen bat is a regular feature of woodland picnic shelters, where it hangs during the daylight hours. They may be found behind the shutters of summer cottages, or in an occasional attic, hollow tree, or cliff crevice. During the winter months they are resident in many of the caves of the State, hibernating with and often among the commoner, clustered little brown bats.

No detailed studies of the life history of this bat have been made and little is definitely known of its reproductive cycle. A single offspring is produced annually, usually in late June or early July.

Keen's bat is found over a large area of the North American continent, and all of the eastern and central United States, north from the Carolinas and Tennessee to southern Canada. A race of this bat appears to be isolated in the Pacific northwest. It occurs throughout the State in the summer months, migrating to the caves for the winter.

This bat's habits closely parallel those of the other little brown bats and *Myotis keenii* does his inadvertent bit in making some little dent in the summertime insect population.

Subspecies in Pennsylvania: Myotis keenii septentrionalis (Trouessart)

Range: Throughout the State.

INDIANA BAT — *Myotis sodalis*

Other names: Pink bat, social bat.

An alternative name, "social bat," is an excellent one for the Indiana bat, describing what is perhaps the most striking single attribute of the animal—that of hibernating in densely packed clusters. However, this can be a bit misleading. The commoner little brown bats *(Myotis lucifugus)* also hibernate in clusters, although not so tightly packed.

The ability to identify sleeping bats from a densely packed cluster is, to say the least, an acquired art. There is, however, a field character which aids in distinguishing these bats in their wintertime caves. The individual bat faces staring out of the clusters of Indiana bats will have pink lips. Those of the little brown bat are a black-brown.

The Indiana bat was not described as a species until 1928, the last Pennsylvania mammal to become known to science. Prior to this time the animal was confused with the very similar little brown bat. In size and proportions the two are almost identical. The Indiana bat does have a smaller hind foot and the calcar has a slight keel that is wanting in the little brown bat, but otherwise the two bats are indistinguishable save for the peculiar coloration of the Indiana bat.

The fur, basically a shade of brown, has a delicate light purple, or pinkish cast to it. The individual hairs of the animal's back are banded, black for the first two-thirds of their length, then light gray, finally tipped with chestnut. The gray band is missing on the little brown bat and its presence on *Myotis sodalis* gives the animal a rather unique pastel shade of light purple-brown. Unfortunately this elusive coloration isn't as apparent as it sounds, unless the bat is viewed in good light and compared directly with speciments of the little brown bat.

The habits of this bat are as unknown as if the creature inhabited the caves of Tibet. They do hibernate, this much is known, and large colonies are restricted to a very few caves, although strays may turn up in any suitable bat cave. Dr. Charles Mohr studied the animal in its winter haunts and believes, after studying the distribution of dormant winter colonies, that the bat is partial to caves which are wet or contain pools or streams of water in them. In such caves they occur in rather sizeable colonies. Mohr (1932) estimated the colonies in Penn's Cave and Aitkin Cave at 2,000 bats and the Hipple Cave population at 500. Smaller colonies of wintering Indiana bats have been reported from caves in Bedford, Center, Fayette, Huntingdon, Mifflin and Westmoreland Counties.

The summertime habits of these species are completely unknown. Despite the fact that as a hibernating animal the Indiana bat is widely distributed over the northeastern states, and not particularly rare, very few have been taken from April through October. They obviously disperse over the countryside but where do they go after leaving the caves? It seems strange that summer specimens or colonies have not been reported. Although its habits undoubtedly parallel those of the little brown bat they apparently differ to some extent. The little brown bat is one of our commonest summertime "attic" bats, but the Indiana bat, in this respect, appears to be highly antisocial.

The concentrated and distressingly vulnerable cave populations of hibernating bats should be left undisturbed. Many of these populations are already under study by biologists and science can best be aided in these cases by leaving them alone. The greatest gap in the knowledge of chiropteran life histories falls during the warm months of the year when they disperse over the countryside. The amateur naturalist could make a solid contribution to natural history by studying the summer habits of these strangest of all mammals—the bats.

Subspecies in Pennsylvania: *Myotis sodalis* Miller and G. M. Allen.

Range: Throughout the State with the possible exception of the southeastern corner.

LEIB BAT ***Myotis subulatus***

Other names: Least brown bat; small-footed Myotis.

In 1842, a Dr. George C. Leib of Erie County, Ohio acquired a rather dubious sort of immortality by sending a specimen of a little bat to Audubon (remembered more for his birds than his bats) and Bachman, another of America's pioneer naturalists. Recognizing it as something new in the line of bats they described it and named the species *leibii*—Leib's bat. In later years it was found that Leib's bat was not a new species, but simply a geographic variety, a subspecies, of a little bat that had been described 19 years earlier under the name of *subulatus,* from a specimen that had been collected along the Arkansas River in Colorado.

On the arid plains of the West and in the Rocky Mountain states, this species, a rather common one, is pale and flaxen-haired, but in the East this same animal is neither flaxen-haired nor common. Here, in Pennsylvania, or rather from Ontario south to North Carolina, and from Kentucky east to the Atlantic, Leib's bat is a warm shade of brown, suffused with a golden tint, strikingly darker than in the western races. The color approximates so closely that of the little brown bat *(Myotis lucifugus)* that it alone is of little help in identification. Leib's bat wears a mask. The face and lips, back to the base of the ears and including the lower lip is black, an easy character to spot on the pale desert bats, but not quite so apparent on the darker Leib's bat.

This bat cannot be identified with any degree of confidence in the field. Its small size (one of the smallest North American bats) and black mask are the most obvious characters that distinguish it from the other cave bats. Technical points such as the flat profile of the skull, the keeled calcar, the comparative lengths of forearm bones and the small hindfeet, are all essential points that aid in identifying this species. However, these are of little help in the field. Identification of the various species of little brown bats (of the genus *Myotis*) is a routine matter in the laboratory, but risky business under the bobbing beam of a caver's headlamp.

Leib's bat averages 3½ inches in length, 1½ inches of which is tail. An adult specimen may weigh as little as 3 grams which is about the same weight as our smallest shrew but actually lighter than a hummingbird by half a gram.

Charles E. Mohr, formerly Director of the Audubon Center, Greenwich, Connecticut, has without doubt handled more living specimens of this rarest of eastern cave bats than any other biologist. For a period of 90 years after this bat was introduced to science, only 18 specimens

were known to have been collected. Mohr, since 1931, has collected, or has banded and released, over 170 individual Leib's bats.

Dr. Mohr has this to say about the Leib bat in Pennsylvania: "Its range in Pennsylvania seems remarkably restricted. Although I have visited almost a hundred caves in Pennsylvania and West Virginia in winter, returning to most of them at least once, I have found the least brown bat in oly 7 caves. With the exception of Dulaney's Cave, [now commercialized and known as Laurel Caverns] where two specimens have been taken, all these caves are located in Centre and Mifflin counties . . . Woodward, Stover, Rossman, Aitkin and Little Aitkin Caves. Indeed a circle with a diameter of about 22 miles would include the 5. These caves harbored 120 specimens."

"The two Aitkin Caves and Stover Cave, which together contained over 100 least bats are located in heavy hemlock forests in the foothills of mountains which rise to 2,000 feet. The other caves occupied are very close to such areas. The caves are usually small, and in the more extensive caves the least bats are found close to the entrances. . . . Exactly half of the least bats found in Pennsylvania, 62, have been found in Stover Cave. This cave is unique in the respect that in it the least bats usually outnumber all other species. . . . A study of Stover Cave leads one to the belief that the cave does not offer sufficient shelter for the social species, but provides enough protection for the hardy least brown bat even in the coldest weather."

This bat has also been taken in Maitland Cave, Mifflin Co., Pennsylvania, and in Virginia, West Virginia, Maryland, New York, Kentucky, North Carolina, Vermont, Ontario and Quebec. Central Pennsylvania remains its center of greatest abundance however.

Leib's bat seems to be a light winter-sleeper, entering the caves later in the fall and emerging in the spring earlier than do the other species of little brown bats. Mohr gives December 1 as the earliest date on which he found this bat in its winter roosts and April 9 as the latest. They apparently move about during the winter period and seem to be as tolerant of cold as are the more ruggedly built big brown bats. Both species hibernate near the mouths of caves or in shallow caves that are too chilly for most bats. This tolerance of the cold in such a tiny bat is worthy of comment and may indicate the presence of some physiological adaptation that the other bats of this group do not possess. Leib's bat hibernates either singly or in groups of 2 or 3 in contrast to its more social cousins who huddle head downward in hibernation.

Nothing is definitely known about the summertime activities of Leib's bat, although it may be assumed that they parallel those of the other species of little brown bats. In the West small nursery colonies have been reported from old buildings; in the East, however, the chance of locating the bats after they have left the caves to spread out over the countryside is almost astronomically slim.

One was taken on Laurel Ridge, in Westmoreland County, Pennsylvania, on July 1, 1950. This sleepy individual, a male, was found under a rock, where it had apparently crawled to pass the day. It is interesting to note that there have been two instances of Leib's bats found in a torpid condition under rocks in caves.

Leib's bat is too rare an animal to affect the face of nature one way or another, but it is a most interesting little mammal from an academic point of view. There is much more that needs to be known about this species—why is it so rare? What lies behind the peculiar distribution? Why is this bat seemingly so tolerant of the cold? What are the facts concerning its reproduction and summer habits? The life history of Pennsylvania's smallest bat may well repay further study.

Subspecies in Pennsylvania: Myotis subulatus leibii (Audubon and Bachman)

Range: Throughout the State.

SILVER-HAIRED BAT ***Lasionycteris noctivagans***

Other names: Silvery black bat.

This bat is a migrant, an all-weather bat that may seek the shelter of a hollow tree, attic, chimney, lumber pile or what-have-you for a time, but pushes on, either north or south with the seasons. It is possible that this bat may breed in some of the cooler, mountainous sections of the State, but the major portion of the silver-haired population migrates right through, only stopping twice a year to pay its respects. During the height of its migration it may be quite common but most of the year it is rare in Pennsylvania.

A silver frosted fur seems to be the common trademark of the migratory species—the red, the hoary, and the silver-haired bats. Despite the rather formidable handicap of just being bats, these three are striking creatures. They have nothing in common with the musty drabness of the cave species and are not at all like the popular conception of a Halloween bat.

The silver-haired bat is of average size, its wingspan slightly under a foot, and its total length 4 inches. This is an easy one to identify correctly. Color alone will do it—dark brown to black fur, the tips of the hairs on the back lightly washed with white to give a silver fox effect. The head and neck are entirely black, the ears oval in outline with a short rounded tragus. The tail membrane, the interfemoral, is furred for half its length, only the posterior one-third to one-half being bare. In our other bats this membrane is either fully furred on its dorsal surface (red, hoary bat) or devoid of all except a few scattered hairs.

Found from coast to coast across the face of America, few mammals can boast of such an extensive range. Yet, from a natural history standpoint, few are as unknown as the silver-haired bat. With most species

of mammals we have at least some idea of where to find them. Even such genuine rarities as the rock shrew and the rock vole have well-defined habitats in which they may be looked for with some assurance of success. But this bat is much like the needle in the haystack. It spreads out over a tremendous area of woodland and, consequently, becomes hard to observe and to study.

During the warmer months the silver-hair prefers the vicinity of stream courses and lake shores. It begins its nightly feeding flights earlier than most bats, often before the sun has set. Its comparatively slow flight is said to be characteristic, but there are many other species of bats taking advantage of the same rising clouds of hovering summer insects and flying the same water courses. They all look much alike, small, erratic, darting shadows in the failing light. There are no pretty colors, nor white outer tail feathers nor specific "bird calls" to guide the bat-looker and most identifications have to be made in the hand.

With the coming of daylight the bat retires to some secluded spot to sleep the day away. The silver-haired bat rarely, if ever, resorts to caves. Specimens have been found in hollow trees, chimneys, hanging from rafters, from twigs, from old bird's nests, almost anywhere it can be assured of a little peace and quiet. It appears to be of a more social nature than the other migratory bats and small colonies have been found hanging together in hollow trees. There is an amazing record, dating from the 1860's, of a colony of some 10,000 of these bats present in an attic in Maryland. If this was not a case of mistaken identity, it was a unique find indeed. There have been no other reports of such huge concentrations and this species is not ordinarily considered an "attic" bat as are some of the little brown bats. They have been captured in houses now and then, and some have been reported spending the winter hanging from the rafters of an unheated cellar. But the silver-haired bat is more the out-door-type in Pennsylvania.

One or two young are born in early summer. Quite helpless at birth, they grow at the fast rate characteristic of most small mammals, and are out on their own in a month's time. This species breeds at a slower rate than do the other tree bats. Both the red and the hoary bat have 4 teats, 2 pectoral and 2 abdominal, and their litters are of corresponding size. But the silver-haired, and all of the remaining species, can accommodate only 2 young.

Beyond the fact that they wing their way south for the winter, little else is known of their wintertime habits. They do not, as far as is known, hibernate in caves, but probably spend the colder parts of the southern winters in a torpid state. They have been found hibernating in cellars, hollow trees and beneath slabs of bark.

Subspecies in Pennsylvania: *Lasionycteris noctivagans* (Le Conte)

Range: Throughout the State.

PYGMY BAT *Pipistrellus subflavus*

Other names: Pipistrelle; Georgian bat; butterfly bat.

The pipistrelle, known as the butterfly bat, is a delicate creature that seems too fragile to survive the buffetings of the world it lives in. Yet it does survive and is not particularly uncommon in the Keystone state.

Size and color identify the pygmy bat. With a wingspan of approximately 9½ inches, a body-tail length of 3½ inches and a weight which varies from 3½ to 8 grams, this species shares honors with the least bat as the smallest North American bat. Loam brown on the back, often with a dull yellow cast, the fur shades to a clay yellow beneath. The hairs on the back are tri-colored—a slate gray at the roots, next a wide area of dirty yellow, followed at the tips by a band of brown. The skin of the wings and the tail membrane is exceptionally thin and delicate, a translucent black. The skin of a pipistrelle's forearm, however, is a light orange-pink and contrasts sharply with the dark skinned forearms of all of our other cave species. This character, its size, color, tri-colored fur and its habit of hibernating singly makes it easy to identify.

The little pipistrelle is one of our deepest winter sleepers, as well as our longest, and it is that intrepid cave explorer—the spelunker—who most often makes its acquaintance. Most bats move about a bit during hibernation and some are rather fitful sleepers, but the pipistrelle may dangle from one spot on a cave wall or tucked into a cranny for months on end, cold, inert, often dotted with tiny water droplets that shimmer with a dead whiteness in the caver's headlamp.

The pipistrelle is not as social as the little brown bat clan; hence, its life history is not as well established. In the wintertime cave, this tiny bat will invariably be found deep inside, far from the mouth of the cavern. Here, scattered thinly, the pipistrelles hang aloof from other species and from each other. From September through April or early May these tiny hermits are features of Pennsylvania's caveland.

When warm weather arrives with its insects, this small predator awakens from its suspended state to go about the vital functions of life. The cave is left behind until next winter, although a few bats may continue to use it for their base of operations throughout the entire summer.

The pattern of reproduction is believed to parallel that of the other species of evening bats, *i.e.* mating in the autumn before hibernation, with ovulation and fertilization deferred until the bat emerges in the spring. The usual number of young is two. Growth is very rapid, as in most small mammals, and the young are indistinguishable from the parents in size and aerial prowess long before their first hibernation. If they manage to survive all of life's vicissitudes, both summer thunderstorms and wintertime bat-happy cavers, pipistrelles, frail and fragile though they may appear, can expect to live for at least 6 to 7 years.

In flight, the tiny pipistrelle has a weak flutter that is quite easily distinguished from the arrowing red bats or the businesslike swoops of the big browns. But for all of its mothlike flutter, the pipistrelle manages to fill up its cavernous little stomach in short order. In thirty minutes of flying time, something like one-fourth of its weight may be supper.

Pipistrelles prepare for their winter sleep by laying up a supply of subcutaneous fat that is slowly burned under the reduced metabolic regimen of the hibernating animal. At the beginning of hibernation, in early fall, females may weigh 7 to 8 grams; the slightly smaller males 5½ to 6 grams. Six months later they emerge from hibernation weighing 5 to 6 grams for the females, 4 to 5 grams for the males, substantially lighter, and substantially hungrier.

This unobtrusive little bat is one the State's most retiring and innocuous mammals. A mayfly may consider the pipistrelle a formidable predator, and so he is in his small world, but few people are aware that he even exists.

Subspecies in Pennsylvania: *Pipistrellus subflavus subflavus* (F. Cuvier)

Range: Throughout the State.

BIG BROWN BAT — *Eptesicus fuscus*

Other names: Rafinesque's bat; house bat.

If you have ever seen a bat at all, the chances are it was a big brown. Here is a bat that flies the city canyons, roosts on multi-million dollar skyscrapers, or squabbles in the cavernous gloom of a storm sewer, with the same ease and aplomb with which it flies in the quiet country lane.

Almost any species of native bat may be found occasionally amid the traffic and the bright lights, especially the migratory species, but the big brown is a part of the human scene almost everywhere in Pennsylvania. Before man built such fancy bat roosts, *Eptescicus* had to live in hollow trees, cliff crevices, loose slabs of bark, caves, etc. In the dead of winter most of them still hibernate in mountain caves, but a few will survive the winter months in such odd spots as sewers, attics, or other places where they can find adequate shelter.

As bats go (and some of the East Indian fruit bats have nearly a five-foot wingspan), the big brown bat is actually a small animal with a body about the size of a small sparrow. But as *Pennsylvania* bats go, it is a large one. The hardiest of our common cave bats, the big brown is a burly muscle-bound, evil-tempered creature. With the exception of the rare hoary bat (which is *big,* but not *brown*) *Eptesicus* is our

largest bat, with a wingspread of 12 inches. The animal measures 4½ to 5 inches from the tip of his (or her) snout to the end of the 2-inch tail. It weighs approximately 14 grams, about one-half the weight of an English sparrow.

Although it seems rather redundant to say so, the big brown bat simply looks like a larger edition of the little brown bat (genus *Myotis*). The same combination of naked black flight membranes and densely furred dark brown body prevails. The ears are relatively shorter, but this character is of little help to the novice in identifying one in the field. Any bat found in Pennsylvania with a wingspan of a foot or over is either this species or the hoary bat *(Lasiurus cinereus)*. If the fur of the bat is a definite dark brown and, if the top surface of the web of skin which extends from the tail to either hind leg (the interfemoral membrane) is bare and not densely furred, it is most certainly a big brown bat.

Most bats have an impressive set of teeth and, if handled, can put these needle sharp weapons to good use on a bare finger. There is nowhere a better example of frustrated rage than a bat that is being held by the tips of his outstretched wings. Far from keeling over from fright as the fragile long-tailed shrews are known to do, a bat is the image of fury itself—straining, chattering, trying to bite anything within reach.

Despite its hearty build and its mouthful of sawtooth teeth, *Eptesicus,* like all of our local bats, is shy in the extreme. The bat seems fearless to us, swooping about the porch of an evening, or back and forth over a definite route, between or around the neighborhood houses. Its self-confidence springs from the same reason that a skunk is at times so supremely aloof and seemingly indifferent to the presence of man. Each has absolute confidence in its power of defense—the skunk a potent perfume, the bat the power of flight. A bat in the air has little to fear and seems to know it. In flight it is dauntless but, when it lands, it is as secretive as most small mammals.

During the summer months the big brown bat begins its night's work just as darkness is beginning to fall in earnest. Leaving its daytime perch it joins the nighthawks and screech owls in their search for night insects. It whips back and forth, wheels, dives and darts with extraordinary bursts of speed for such a small creature, an impression heightened by the falling and the flickering erratic flight of the bat. Hunting by echo-location, it usually has its fill of insects during the first few hours of the evening. Possibly a second, pre-dawn excursion takes place as well.

At dawn, the bat is back in its daytime retreat where it lapses into a comatose sleep. This "fly-by-night" existence continues until late in

the fall, at which time a local migration takes place and a majority of the big brown bats resort to one of the more than 300 Pennsylvania caves. They straggle in from October until very often as late as December. A wintertime trip into a cave containing hibernating bats will reveal the fact that different species show decided preferences as to hibernating sites. The various little brown bats, *Myotis lucifugus, M. sodalis, M. keenii,* will be found well away from the mouth of the cave, deep underground, hanging in compact clusters. The little pipistrelle will be found tucked away by itself, in some out-of-the-way cranny, far beyond the reach of the elements. The big brown bat, however, elects to hibernate close to the mouth of a cave, not far beyond the zone where temperatures may drop below freezing. Big brown bats have been collected in the "Dining Room" at Dulany's Cave, Fayette County, Pennsylvania, (now commercialized and called Laurel Caverns) at a time when the little stream in the same chamber was a ribbon of ice. *Eptesicus* hibernates singly and never in the concentration of the more social species.

As soon as the weather warms enough to coax out the first broods of spring insects, the big brown bat emerges from its cave, mine-shaft or cellar to begin life anew. Banding records indicate that this bat may live as long as 9 years.

In early April the female sheds one, or more often, two eggs from her ovaries. These eggs are then fertilized by spermatozoa which have remained inactive in the uterus of the female throughout the period of hibernation, mating having occurred the previous fall. The gestation period is approximately 6 weeks and the large, active, but still relatively helpless young are born in an advanced state of development, able to crawl and cling to everything they touch. This is an important attribute for, if the youngsters were to fall to the ground at any time during these early days, they would in all probability be lost for good.

A baby bat, weighing about 2.5 grams, hairless and wrinkled, will in 6 weeks' time become almost indistinguishable from the adult. The young, usually twins, are born in nursery colonies, composed solely of females. The males at this time of the year lead a solitary existence. As the young progress and become independent, some of the adult males drift into these summer colonies where they remain until winter winds break up the colonies.

Big brown bats are common throughout the State, and are often seen on summer evenings "bugging" about the city streetlights and competing with the nighthawks.

Subspecies in Pennsylvania: *Eptesicus fuscus fuscus* (Palisot de Beauvois).

Range: Throughout the State.

RED BAT ***Lasiurus borealis***

Other names: Tree bat.

In the spring, particularly in May and early June, the Pennsylvania hills explode in a shower of birdlife. Some of these bubbling migrants come to brighten up a woodlot for a few hours at most before they push on to the north; others come to stay. Riding the crest of these yearly migrations come three species of bats—the red bat, the silver-haired and the hoary bat. Unhonored and unsung, these bats, perhaps inadvertently, often migrate with the flocks of songbirds. In the fall of the year they wing their way south again. This trio, the tree bats, leave their more conventional brethren in northern caves in order to spend the winter amid more congenial surroundings.

The red bat is one of the most beautifully colored mammals in the State. Like the birds, whose world it shares, the male is the gaudier of the sexes. A male red bat is unmistakable. Its mouse-size, half-ounce body is densely furred with a long, loose pelage of a very pleasing shade of red-orange-brown (the *original* brick-bat!), somewhat the color of a red fox. Most intense on the back, the color fades to a dull yellow about the face, and to a light cinnamon beneath. Some individuals are frosted, *i. e.* the tips of the hairs, usually on the throat and the shoulders, are tipped with white, not enough to effect the overall color of the animal, but just enough to give a delicate frosted appearance to the pelage. Female red bats are a bleached straw color frosted with white on the dorsal surface and are slightly browner beneath. Both sexes have a well-defined spot of white fur on the shoulder at the point where the wing joins the body. The upper surface of the interfemoral membrane, the flight web which stretches from tail tip to both ankles, is completely covered with rust-colored fur. The furred flight membrane is a feature of all three of the local tree bats but that same membrane is bare, or essentially so, on those species that habitually hang up for the day in more sheltered situations.

A red bat in silhouette against the evening sky looks like a miniature nighthawk. A wingspan of about 11 inches and a total length of 4 inches makes it above average in size, slightly larger than all of the cave bats except the burly big brown bat and somewhat smaller than the hoary bat.

With some practice a few bats can be identified on the wing. The tree bats have a stronger, less erratic wingbeat, more swallow-like than that of the cave species. This coupled with the fact that the red bat starts to fly earlier in the evening than most bats, often when there is still light enough to spot its distinctive coloration, makes it possible to identify this species on the wing when seen under favorable circumstances.

The daylight hours are spent clinging to the undersurface of a green leaf or dangling head downward from a branch in deep sleep. Playing the recluse as it does, this bat rarely comes to our attention even though

quite common in Pennsylvania. The social species—the little browns and the big browns that hold conclaves in our attics and hibernate at times in blanket concentrations—seem more common because we run across them oftener.

Red bats will return to the same tree, very often to the same twig, for days on end. Daylight apparently has little effect on their choice of a roost. They are often found in the most exposed situations in full sunlight. Actually these bright little bats are well camouflaged and often look like dead leaves.

Red bats mate in August or early September. The process may begin in the air and end in a confusion of wings tumbling earthward where actual mating takes place. During this single-minded time the bats are grounded, apparently oblivious to all else, and are extremely vulnerable to predation. Since the young are born the following spring, this would indicate an exceptionally long gestation period for such a small mammal. But, as in the case of most other vespertilionid bats whose reproductive cycle has been worked out in any detail, the sperm cells are apparently stored in the female where they remain inactive until ovulation occurs in spring. Only then does fertilization take place and the development of the embryo start.

Life for a red bat starts in early summer. The mother prepares nothing in the way of a maternity ward, and the young, from 1 to 4, are born in the tree tops. The young are blind at birth, hairless, pink, unable to fly, equipped only with powerful instincts to cling and to suck, and they cling like little leeches. Baby bats grow very rapidly. The young accompany their mother on her nightly forays clinging tightly to her breast, until they grow large enough to interfere with flight. Females have occasionally been picked up that were grounded by the combined weight of their offspring. From then on they remain huddled on the maternal leaf until the parent bat returns. It doesn't take much longer than a month for the young to grow to adult size. As soon as the young are weaned and self-sufficient, they scatter and the family group is no more.

The litter size, up to 4, is large for a bat and probably reflects a higher mortality rate for this species, exposed as it is throughout the year. Summer storms, with their hail and high winds, help to reduce their numbers. The long migratory flights of the tree bats have many elements of danger to them. Many migrating bats, as well as songbirds, are caught in storms or swept to sea by unfavorable winds. Some beat their way back to land or find refuge on a passing ship; those not so fortunate die at sea.

In September or October, depending upon the weather, the red bat heads south. The details of this migration are none too clear. It seems to be a haphazard affair and to take place largely by night. They do not gather into large premigrational flocks as do many of the songbirds but

THE RED BAT is one of the most beautifully colored mammals in the State. Its mouse-like body is densely furred with a long, loose pelage of a very pleasing shade of red-orange-brown. Here a female flies with and cares for her young.

beat their way south singly. Occasionally, during the height of the fall migrations, weather conditions will force birds to fly so low that often hundreds will be killed by dashing against skyscrapers or high radio and television antennae. Mixed with the feathered victims, very often, are bodies of migrating red and silver-haired bats. Red bats, in the northern latitudes of their far-flung range, apparently spend their winters in the southern states and return north again in the spring.

In some areas, this is one of Pennsylvania's commonest bats. During the summer months resident bats may be expected anywhere in the State, and during the spring or fall months migrant individuals may occur as well. Although an occasional individual may seek temporary shelter in a cave rather than in trees or bushes, there has been no report of the red bat wintering over in Pennsylvania caves.

This strong flyer, as a species, has a tremendous range, from the Atlantic to the Pacific and from southern Canada to below the Rio Grande, most abundantly in forested country.

Subspecies in Pennsylvania: Lasiurus borealis borealis (Müller).

Range: Throughout the State.

SEMINOLE BAT — *Lasiurus seminolus*

Other names: Mahogany bat.

The Seminole bat is a native of the deep South, where it spends its days dangling in moss-hung shade, and its evenings snapping insects out of the Dixie air. Its normal range includes Florida, most of Georgia, Alabama, and the southern coastal areas of South Carolina, Mississippi and Louisiana. There are a few extra-territorial records, however, two of which are from Pennsylvania.

Except for the dark mahogany brown fur this might be a red bat, the two species resembling each other that closely. In fact, it was considered by many naturalists to be a color variation of the red bat *(Lasiurus borealis)*. Observations of their habits and their distribution, however, have shown them to be two separate but closely related species. Although they occupy common ground and hunt the same night skies in the South, they never interbreed.

The fur is a deep brown, lightly dusted with silver, but with none of the red or red-brown cast so characteristic of the red bat. Female red bats are strikingly lighter in color than the males, some almost a straw color, but the Seminole bat's lady is as intensely brown as her mate. They all possess the white patch of fur at each "shoulder."

During the warm summer months some of these bats apparently become a little more adventuresome, and by fall a few of them may work their way—or perhaps are buffeted north by storm winds—up along the

east coast for considerable distances. The two Pennsylvania specimens, both taken by Samuel Wishnieski, interestingly enough, were also collected in the fall of the year, one at Hopewell in Berks County on September 12, 1931; the other on October 20, 1945, in Lancaster County. The October record was picked up dead on the bank of the Susquehanna River. Was it inevitable fate or just coincidence?

The habits of the Seminole bat, as far as they are known, closely parallel those of the other tree bats. They do not, however, migrate north to our chilly latitudes and the few records we have are purely accidental. In the South they fly in company with many other species of insect-eating bats. The Seminole bat seems to be a slower breeder than its fox-red relative. The annual litters are more often twins; while, in the case of the red bats, triplets, or even quadruplets, are the rule.

The Seminole bat has one added distinction: it was first described in scientific literature by Samuel N. Rhoads, one of the country's earlier mammalogists and author of the first "Mammals of Pennsylvania" (1903).

Subspecies in Pennsylvania: Lasiurus seminolus (Rhoads).

Range: Eastern part of State.

HOARY BAT — *Lasiurus cinereus*

Other names: No others in common use.

The hoary bat seems to go with wilderness country, with canoe paddles and the campfire-smells of balsam, wet woods and bacon. An impressive creature with a 15-inch wingspan the hoary bat begins its hawk-like flight only after the last rays of the sunset give way to the stars. This is the largest bat of our eastern forests. Yet, owing perhaps more to its solitary forest life and retiring habits than to its actual numbers, the hoary bat is one of our rarest species.

This bat ranges over most of the North American continent south of the tree line of the Canadian tundra, a migratory wanderer that drifts with the weather and the season, north during the warm months of the year and south again for the winter. Pennsylvania lies on the southern edge of its expanded summer range and the northern limit of its winter-time haunts. This bat is so rarely seen that it is impossible to observe the migration of any individual. We know, in general terms, that their migration parallels that of the insectivorous birds.

Once seen, the hoary bat is not easily forgotten. This is a handsome animal, bat or no bat. It looks like a creature of the northland, densely furred with a full, soft coat of many colors, a mixture of yellows and warm browns, silvered with hoary tips on the hairs of the back and the tail membrane. It looks almost as if Jack Frost had breathed upon each hair. The amount of frosting varies from bat to bat, and some appear

browner than others. The hair of the throat is unusually full, and buff in color, forming a ruff or a gorget of light hairs.

This species, the gypsy-like red bat, and to a lesser extent, the silver-haired bat have the interfemoral membrane well covered with fur. The flight membranes of the cave inhabiting bats are essentially bare in contrast. The underside of the long, winglike arms of the hoary bat are furred from "armpit" to elbow and wrist. The legs and feet are furry and the short, broad ears are furred almost out to their black, bare rims. The face is well furred and black. A hoary bat at rest, with its wings tucked closely to its sides, is indeed a well insulated little animal.

This bat isn't likely to be mistaken for any other in the State. Some individuals of the red bats, however, do have a grizzled appearance which closely approaches that of their larger cousin. A 12 to 15 inch wingspan, a total length of 5 to 6 inches, yellow ruff, black rimmed ears and over-all gray brown will serve to distinguish the hoary bat. The tooth arrangement (one upper incisor on each side instead of two) will serve to separate it from any other North American bat except the red and the vastly dissimilar evening bat.

As winter gives way to spring these impressive bats sweep north on long pointed wings that give a hawk-like efficiency to their flight. Taking up residence in the trees, they pass the day in some shady bower and are said to be the last bat to take flight in the evening, long after the other local species have started to hunt. Merriam believed that this habit of remaining on the perch until the last light was drained from the skies contributed to the hoary bat's apparent rarity. Noticing that they took wing a little earlier on cooler evenings, Merriam decided they were waiting not only until the night was dark enough but until the temperature was *cool* enough.

Nocturnal insects undoubtedly make up the diet of this big bat, but what insects? Its superior size would seem to suit it for bigger and better "bugs" than the tiny pygmy bat could tackle, for instance. Few people have ever seen it actually hunting for any extended period of time. If seen at all by the naturalist it is usually over the sights of a shot gun. With the dawn this bat returns to the trees often to the same spot as the previous day.

The young are born in late May or early July. These bats do not gather into the nursery colonies so commonly formed by many of the cave bats. Their offspring, usually 2 or 3, occasionally as high as 4, are born in lofty seclusion amid the green shade of a sheltering tree. The young remain with the mother, clinging tightly to her fur until they outgrow their free ride. After about 2 weeks they stay behind on the tree during the hunting trips of the female. At the end of a month the young, already adult size, disperse to a solitary existence. There is some evidence that mating occurs in the late summer, August or

September, but ovulation and actual fertilization of the eggs may be deferred until spring.

The southern migration of the hoary bat seems to be a willy-nilly affair. No large flights have been observed but individual bats seem to give ground before the weather. One was seen hunting in daylight hours during a February thaw at Collingdale, near Philadelphia. In their southern haunts they may spend cold snaps in semi-hibernation and remain active throughout most of the winter.

The hoary bat breeds as far south as Pennsylvania and adults with young have been taken on several occasions in this State. But it seems to prefer the northlands and is more a symbol of the Adirondack spruces and the mirror lakes of Canada.

Subspecies in Pennsylvania: *Lasiurus cinereus cinereus* (Palisot de Beauvois).

Range: Throughout the State.

EVENING BAT ***Nycticeius humeralis***

Other names: Rafinesque's bat; twilight bat.

The twilight bat is a common "attic bat" in the South. Preferring the palmettoed climate of Dixie, it rarely ventures across Pennsylvania's southern borders, and so qualifies as one of Pennsylvania's mammalian rarities. However, there have been at least three reports of *Nycticeius* in the State.

Best described by comparing it with the common little brown bat *(Myotis lucifugus),* it differs from all other small brown bats in the number of upper front teeth—one on each side in front of the lion-like canines rather than two. Externally, this bat is easily mistaken for the little brown bat, but the fur, as befitting a southern bat, is shorter, sparser, and more closely confined to the body. All of the flight membranes, including that of the tail, are black, bare and, when compared with those of the other small bats, thick and leathery. The ears are black and bare and afford another means of identification. The tragus is short, blunt and bent forward in Rafinesque's bat but is long and pointed in the little brown bats.

Shunning the cooler central mountainous areas of Pennsylvania, the twilight bat has strayed across the Mason-Dixon line only in the two southern corners of the State. S. F. Baird, one of the great pioneer naturalists of this country, captured a series of 12 at Carlisle in the 1850's. They are still preserved in the U. S. National Museum at Washington, D. C. Some fifty years later, H. A. Surface, then the State Zoologist, identified a twilight bat from Buckingham, Bucks County, Pennsylvania. Apparently there have been no recent published records of this species in southeastern Pennsylvania. Mr. Clay L.

Gifford, who collected extensively in the vicinity of Waynesburg, Greene County, in extreme southwestern Pennsylvania, reported the former presence of a colony of these bats in the attic of one of the buildings on the campus of Waynesburg College.

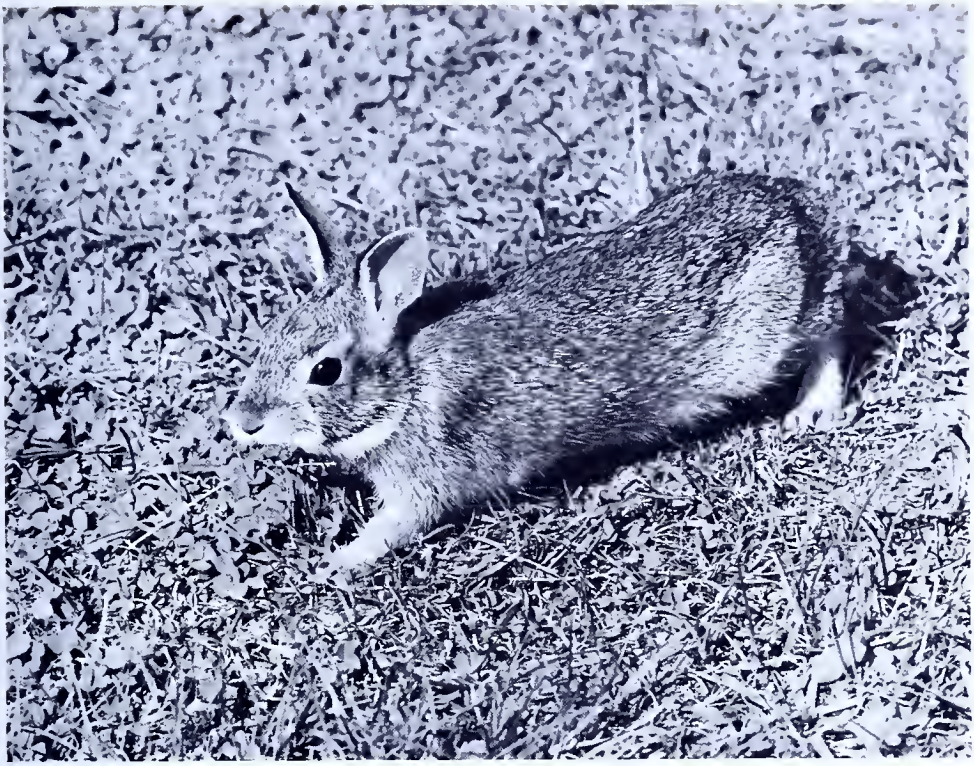
Its summertime habits are similar to that of the little brown bat. Nursery colonies congregate in attics, belfries, hollow trees and other spots affording suitable protection and seclusion. These colonies persist throughout the summer, breaking up at the approach of cooler weather. Those bats which are beyond their normal northern limits may migrate to the south. In the south this species is active throughout the year.

There is no record of the twilight bat breeding in Pennsylvania. However, this bat is so easily mistaken for the little brown bat that many colonies may be in existence and have remained unnoted. After all, there aren't *too* many people who much care what bat occurs in what attic!

Despite its close resemblance to the cave bats, this species apparently does not resort to caves at any time of the year.

Subspecies in Pennsylvania: *Nycticeius humeralis humeralis* (Rafinesque)

Range: In Pennsylvania reported only from Greene, Bucks and Cumberland Counties.



COTTONTAIL RABBIT is ane animal that has benefitted fram man's clearing af the forests of Pennsylvania. They were relatively uncamman befare the days af the pianeer. The average life span af a cattontail taday, hawever, is far less than a year, but they are plentiful in many areas.

EASTERN COTTONTAIL ***Sylvilagus floridanus***

Other names: Rabbit, bunny, powderpuff.

Autumn is the time of the hunter.

When Orion rises in the evening sky to shine the frosty night through and when the hunter gulps a cup of steaming coffee in the near dawn, rabbit season has arrived. Rabbit hunting is more than just a delicious piece of meat smothered in thick gravy—it's beagle music filling the crisp morning air—a fencerow adorned with red-feathered sumac—an appetite which seems insatiable—and memories of frost-burned sunsets and bobbing "powderpuffs" between the rows of standing corn.

This favorite of the hunter, the cottontail, is not an animal of the wilderness. Instead it thrives in the farming districts of the State, in suburban lots, back lawns, cemeteries, old fields, roadsides, abandoned brushy areas that have sprung up in blackberry thickets, in open woods that are well-spotted with underbrush and grassy patches or in forest edges where brush and clover (or grass or new-planted beans) grow close together.

This most familiar of animals is one of those forms of wildlife which has actually benefited by the clearing and plowing of Penn's Woods and

by the farming activities of man. Cottontails were relatively uncommon in Pennsylvania before the days of the pioneer. They shunned the big woods where the leafy canopy was too high to do a rabbit any good and too shady to permit any underbrush or grass to grow. Apparently, they were closely restricted to the glades and the river meadows at that time. The Indians were seldom able to find them, judging from the few rabbit bones that have turned up in archaeological excavations, amid a profusion of remains of true woodland creatures like squirrels, raccoons and wild turkeys.

The cottontail hardly needs to be described to anyone. However, it could be confused with two other native rabbits. One, the snowshoe hare, is limited to the northern mountain areas of the State. It is of

PENNSYLVANIA'S NUMBER ONE game animal, the cottontail is the abject af much sparting activity. The Internatianal Beagle Trials are held annually in Allegheny County where the rabbit affers excellent chase. It is found commanly in the southern and eastern areas of the State.

somewhat larger size with black-tipped ears and a shaggy white winter coat. The other, the wood rabbit or New England cottontail, is somewhat smaller than the eastern cottontail and is restricted to the northern and mountainous areas of the State, also. But both may occur together in places and are so alike that they cannot be separated easily by external examination. The best characteristics for separating them appear in the skull.

The average cottontail will weigh between 2 and 3 pounds and females are slightly heavier than the males. Growth is exceedingly rapid and a young rabbit born helpless, blind and essentially naked, will be alert, fully furred, weaned and on his own in a month's time.

Rabbits have been kept in captivity for as long as 10 years, but the average life expectancy of a cottontail in the wild is far less than a year. They lead exceedingly precarious lives. Field studies indicate that 35 percent of all of the young never survive the first month and that the average juvenile mortality rate is at least 65 percent. This means that during the hunting season, the rabbit population will consist of at least 7 young of the year to every 3 animals that have managed to survive one winter or more.

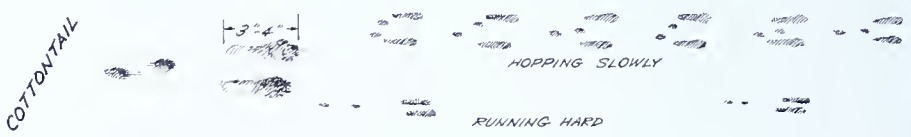
With the odds stacked so heavily against them, the number of rabbits in any given area coincides pretty closely with the ability of the land to hide them from their enemies and to feed them. The fact that rabbits occur all over the suburban areas, but are quite often scarce on the outlying farms, is no accident. This unexpected situation has little to do with hunting pressure, but instead results from the presence or absence of proper food and cover. Around the edges of towns, there is almost always plenty of food (all those lawns) and plenty of cover for rabbits to hide in, or under, and in which to raise their young. On the other hand, many modern farms are singularly barren of weeds, brush or natural cover in which a rabbit will be secure from its enemies, the predators.

Trapping studies show that really good rabbit habitat cannot be hunted out. In other words, there will be enough breeding stock left at the season's end to provide plenty of rabbits for the next hunting season. This depends entirely upon those same two magic words—food and cover. Improve the range and the rabbit does the rest. Wholesale introduction and stocking of rabbits (58,404 cottontails from Kansas and Missouri were stocked in this State during the 1924-25 season alone) is money and effort well meant but misdirected. And predator control, an expensive business, has little effect upon rabbit numbers in the long run, despite its obvious appeal. What is needed to sustain a high level of rabbits is widespread habitat improvement. This is so because Pennsylvania is growing up once again into forest and, if left untouched, much good rabbit habitat will rapidly disappear.

Rabbits are reasonably adaptable animals, but they will not thrive and multiply unless they find a good food supply in the form of fresh grasses, herbs, legumes, blackberry or raspberry canes, fallen fruit, bark, and similar items in close proximity to a place of refuge, such as briar patches, down-timber or slashings, woodchuck holes or dense weedy fields. The thin-soiled acid fields of farmed-out country, matted with poverty grass, support few if any rabbits; the grazed woodlot with its bare, leaf-littered, sunshaded floor holds no rabbits, either. But when conditions are naturally suitable, or man deliberately makes them so, then rabbits will thrive. Controlled cutting of pole timber on a woods edge; plowing, liming and planting strips of legumes and grasses; allowing gullies and fencerows to grow into sanctuaries of brush; in other words, meeting these essential requirements of food and cover are the practices which produce plenty of cottontails and good hunting.

Young are born in a nest lined with fur which the doe plucks from her own body. The nests are cunningly concealed and, even when built in exposed situation, are not easily found. But in spite of her caution and care, nestling mortality rate is high. Spring floods, heavy rains, foxes, weasels, dogs, snakes, cultivation and brush fires all take their toll. It is only through sheer force of numbers that the rabbit holds its own in a hostile world. Breeding season begins in early spring and by late March or early April the first litters of the year appear. After a gestation period of about 30 days, from 3 to 8 (usually about 5) young are born. The doe is usually bred again immediately, and litter follows litter at approximately monthly intervals throughout the warmer months of the year. And, female cottontails born in early spring will have litters of their own before late summer, thus compounding production. Reproduction ceases during the fall and winter, but occasionally a hunter, while dressing his rabbit, will find a pregnant female in November or even December. Such litters, even if they were born, would stand little chance of survival in a northern winter. Each doe is theoretically capable of producing about 25 offspring a year (5 litters of 5 each); in actual practice, however, making average allowance for juvenile mortality, about 4 to 8 will survive until hunting season, depending upon the suitability of the area for supporting rabbits.

As soon as they are weaned and leave the nest, rabbits lead a more or less solitary life. They have very definite home ranges and are likely to stay within the confines of a single acre for their entire life providing living conditions are suitable. The size of the home range may be as



little as ¼ acre or as much as 10 acres, all depending upon the availability of food and cover. Rabbits are very reluctant to leave their home territory even when hardpressed by dogs. They know every hollow log, woodchuck hole and briar patch by heart and will circle around within that area rather than enter strange territory, an idiosyncracy that often lands them in a rabbit stew.

Rabbits remain active throughout the year, although they may usurp a "closed-for-the-season" woodchuck hole to wait out a spell of unusually bad weather. They do not dig burrows but take advantage of the woodchuck's involuntary hospitality during periods of extreme cold and extreme heat.

During milder weather, the rabbit will most often sit out all day in a "form" created by tramping a sitting place in heavy grass or weeds. At times, it will sit in the open woods with its back against an old stump or the base of a tree.

Rabbits are basically nocturnal, but are sometimes seen during the early morning hours or in the late evening. They are a familiar sight to the motorist at night as they feed on the roadside grass. And it is hard to drive for too many miles without seeing the carcass of a rabbit or two who coudn't quite cope with the speed of an oncoming car. Cars are not the only problems besetting the rabbit. They are eagerly taken by an army of predators—foxes, weasels, mink, hawks, owls, snakes, cats and dogs—just to name a few. Death is everywhere for the unwary.

But there is nothing unwary about this animal as a rule. Sitting tight and almost invisible in his coat of camouflage brown, he often passes unnoticed. But let the pursuer approach within a certain "panic range" and the rabbit explodes like a rocket, dodging and bobbing away to disappear beyond gun range in almost (but not quite) as much time as it takes to raise gunstock to shoulder.

The cottontail is Pennsylvania's number one game animal and is likely to remain so for a good many years. Much time, money, research and effort have been put into rabbit management in this State to provide the hunter with more and better sport and an opportunity to participate in this wholesome, healthful form of outdoor recreation.

Subspecies in Pennsylvania: Sylvilagus floridanus mallurus (Thomas).

Range: Southern and eastern part of the State.

Sylvilagus floridanus mearnsii (J. A. Allen).

Range: Northern and northwestern parts of the State.

NEW ENGLAND COTTONTAIL *Sylvilagus transitionalis*

Other names: Wood rabbit; mountain cottontail.

The New England cottontail managed to escape the scientific eye until 1895. Its range is entirely within the eastern United States and it is as good a game animal and is often as abundant as the "common" eastern cottontail rabbit. No doubt, more than one eminent scientist in the early days returned home in the evening to dine on this undescribed species without realizing that he had a "find" right under his nose!

But one look at the animal is enough to make one understand why this should have been so. Externally the New England and the eastern cottontail rabbits are almost identical. The wood rabbit is smaller by an inch in overall length and lighter by a quarter of a pound, but the overlap between the two is so great that this difference is often not apparent. The back and sides of the wood rabbit have a finer marbling or peppering of black-tipped hairs against a brown background. It has a reddish-cast to the upper parts and is not as gray as the eastern cottontail, especially on the sides. But this color difference is so subtle and individual rabbits are so variable that these characters are of little help in the field. Wood rabbits invariably have an ill-defined black spot between the ears, but then so do some eastern cottontails. They never have a trace of the white blaze that many of the eastern cottontails have on their foreheads. The ears of the New England cottontail are shorter, but it is almost misleading to say so, because the average difference only amounts to about 1/16 of an inch. The skulls of the two are distinct, however. The most obvious difference lies in the shape of the supraorbital processes—large and massive in the eastern cottontail, slim and weak in the wood rabbit. The quickest way to get an identification is to submit the animal (its head alone will suffice) to a museum.

In Pennsylvania this is a mountain rabbit, most common in the higher portions of the northeastern and central parts of the State. Actually it ranges from northern New England to Alabama and Georgia in the higher portions of the Appalachian mountains. Both species occur together in the mountainous areas of the State.

The New England cottontail is reputed to have a greater preference for woods and dense brush than the more open-country cottontail and is rapidly replaced by its larger relative when the land is cleared and cultivated. This has been observed in Massachusetts where the change is still taking place. The consistently small size of the rabbit bones recovered from prehistoric Indian sites along the Ohio and lower Susquehanna drainages, and the presence of wood rabbit skulls in a cave deposit in Bedford County, suggest that the animals once had a far more extensive distribution in the State than they do today.

Its habits, so far as they have been studied, are similar to those of the common cottontail, but it is so easily confused with that species that

valid observations are few and far between. The Game Commission does not list the animal as a separate game species because of the impracticability of identifying it afield and the similarity of habits. The fact that it does show a preference for more wooded areas suggests that there may be more difference in habits between the two than are suspected.

The two species have interbred in captivity, but there is no evidence that they do so in the wild.

However, one tastes as good as the other, and to the average hunter just which one falls to his gun is of little consequence. But to the professional wildlife worker, either in field or laboratory, it is quite often of vital concern to know just which species he is working with. Despite their obvious similaries, the eastern cottontail *(Sylvilagus floridanus)* and the New England cottontail, *(Sylvilagus transitionalis)* are two separate and distinct animals.

Subspecies in Pennsylvania: Sylvilagus transitionalis (Bangs).

Range: Throughout the State except the extreme western part.

RABBIT DAMAGE is not uncommon when deep snow ond icy crusts prevent them from feeding on normol food. Orchordists, particularly, ore concerned obout this form of winter destruction to their trees.

SNOWSHOE HARE *Lepus americanus*

Other names: Snowshoe rabbit, white rabbit, varying hare.

"Timbe-r-r-r!" and a 200-foot white pine came down with a whistle of wind and a crash, to dwarf the men who cut it and the oxen who pulled it to the Allegheny or the Clarion, the Sinnemahoning or the Susquehanna rivers. As far as the eye could see, logs bobbed in white water races to meet the sawblades of a wood-hungry young nation. Daylight was being let into the swamps, there was little doubt of that. And the snowshoe, the white rabbit of the wilderness, hopped about the outskirts of many a logging camp of a century ago, unaware that its day was about to close, that Penn's wilderness of wolves, of elk—and of snowshoes—was about over.

Cottontails have now invaded the timbered-off land and pasture and pole timber has largely supplanted the pines. Perhaps most damaging of all, the man-managed deer, now more common than the snowshoe itself, has scoured the woods of those twigs and buds without which a winter-pinched snowshoe cannot survive. But despite all, the snowshoe rabbit—or varying hare—missed becoming a part of Penn's past by a mere hare's-breadth. It is still there today, in favored localities, to serve as a living link with the powderhorns and pines of a wilderness era.

This is a first-rate game animal, big (3 to 5 pounds), fast (up to 10 feet at a bound), well camouflaged and tricky to hit. It rarely holes up like the cottontail and has earned a well deserved reputation as one of the State's foremost game species. Penn's Woods would never be quite the same should we lose it to the "progress" we see all about us.

This is our only native hare, but the distinction is rather a subtle one. All hares are "rabbits" in the broad sense of the word. They differ from the true rabbits, however, by being larger, more specialized as a running and leaping animal, and by giving birth to young that are already furred and have their eyes open.

The snowshoe is one of four Pennsylvania mammals to turn white in the winter and is the only one of our rabbits to do so. From November through March this is a white animal (not an albino, which is something quite different), almost invisible in a snow covered landscape save for the black tips of his long ears and his equally dark eyes. A true albino has no color in skin, fur, nails, or eyes and the typical pink eye is colored only by the blood coursing through its vessels. Part the fur of the all-white winter snowshoe and a band of tan appears, followed at the roots by a band of gray. So the snowshoe's white coat isn't even skin-deep but, due to the denseness of its winter coat, the hare appears an all-over white. The fur on the belly *is* white clear to its roots, however. Most Pennsylvania snowshoes retain some brown on their legs and occasionally on their heads throughout the winter. The outer one-third of the ear is rimmed with a thin pencilling of black which contrasts

handsomely with the all-white rabbit. Occasionally coal black individuals have been reported and true albino snowshoes are even rarer.

Aside from its larger size, the snowshoe differs from the cottontail in many respects. As might be expected from its greater running ability, the feet of the snowshoe are large and the legs long. The 4-inch hind foot of a cottontail (measured from heel to longest claw) is dwarfed beside the 6-inch "snowshoes" of the hare. During the winter months the fur on the bottom of each foot increases to over an inch in depth to make a dense, warm, skid-proof overshoe. Because of it, their tracks are easily identified in the snow, almost as if a four-legged powderpuff had hopped by that way. The snowshoe, in addition to outweighing the cottontail by a pound or 2, is some 2 inches longer from nose to tail (17 inches as against the 19 inches for the snowshoe). But the tail is actually shorter, although neither has much room for bragging (1½ inches—snowshoe, 1¾ inches—cottontail). These are all average figures, and individuals vary, especially with age, but the big feet are his trademark.

From spring until fall, this is a brown animal. The coat does not change color but is completely shed and replaced by a new one. The ears still retain their black rims, but the animal now resembles a large, brightly colored cottontail. The white of the neck and forelegs turns to a cinnamon red which washes over the now olive-brown flanks. The brown of the back, which lightens to tan on the head, is heavily sprinkled with black. The top of the tail is completely black. The throat, the belly, and the underside of the tail remain white at all seasons. Summer or winter, the snowshoe is a handsome beast.

In contrast to the cottontails, which prefer more southerly climes and barely penetrate beyond southern Canada, the snowshoe is a northern rabbit. It is found throughout the 5,000 mile sweep of spruce-forested north woods from Alaska to Labrador, north to beyond the Arctic Circle and south to Pennsylvania. It extends even farther south, but only in the high Appalachians.

This is a north woods rabbit and, in the forested areas typical of the Canadian north, it sometimes builds up to incredible numbers—hundreds per square mile. But here in Pennsylvania, its range is so limited and hunting pressure so strong that snowshoes barely hold their own. The Game Commission, from time to time, has imported and released hares in areas where they once occurred, with varying degrees of success.

The snowshoe, before the State was logged off, was found from Pymatuning in the west clear across the northern half of the State to the far eastern Pocono Mountain country of Wayne and Pike Counties. They extended south along the mountains in lessening numbers to Centre and Mifflin Counties. They avoided the lowlands both east and west of the mountains where the cottontail held sway. Today the range of the snowshoe is quite restricted.

Favored habitat is found in cool, shrubby bogs or swampland thickly overgrown with rhododendron, hemlock, willows, alders or brush. Heavily browsed or upland forests that are unbroken by clearings and are densely shaded are not for the snowshoe, nor are they for any of the cottontails for that matter. The snowshoe is a creature of the northern thickets, where the forest is broken into forest-edge situations and where sunlight can penetrate to promote the growth of a woody understory low enough for a rabbit to reach. If he finds a swampy stretch of spruce in the Poconos or a dense hemlock bog in the mountains, thick with the green leather of rhododendron and the smell of the north woods, the hunter may still see this wilderness rabbit.

Primarily a vegetarian, the food of the snowshoe is somewhat like that of the cottontail. During the summer it subsists on a variety of grasses and herbs. But during the long winters of its northern haunts it turns to browsing, nibbling on the buds, twigs and bark of many dormant species and on the needles and leaves of the evergreens. Fir and hemlock needles, the leaves of laurel and rhododendron, the bark of aspen or birch, or any of a number of thin-barked trees, are avidly eaten. A diet of spruce needles may make for a poorly tasting rabbit stew, but, ordinarily, the flesh is delicious.

The deep snows of winter have little effect upon these insulated animals. The deeper the snow, the better, in fact, for now the snowshoe can reach higher than ever, and an extra strata of the forest becomes his to nibble on. Poor times are ahead for the snowshoe when the winter is a mild one.

Enemies are legion and snowshoes are only a few bounds from a swift death most of their short lives. Owls are a constant menace to the snowshoe—big ones like the great horned owl and the snowy owl that swoop down with the silence of death before the rabbit is aware that anything is amiss. Snakes may take an occasional young one, but are scarcely a menace. Foxes, bobcats, weasels and "lead poisoning" are the immediate dangers.

But perhaps its worst enemy, although the hare would hardly recognize it as such, is the white-tailed deer. A snowshoe just can't compete with a deer herd and this is the single most important deterrent to increasing the snowshoe population—a deer-scoured forest. Deer, when they increase in numbers beyond the ability of the land to feed them,

will crowd out the snowshoes simply by leaving them nothing at all to eat and nothing to hide under. A rabbit obviously cannot reach as high as a deer to nibble a bud or eat a leaf.

The unseen enemy—the browsed-out woods and the encroachment of civilization—has turned the snowshoe into a second class citizen in his own backyard. Perhaps nowhere is the "balance of nature" so vividly brought out as it is in the plight of the snowshoe. And it is a lesson to remember. Each of the many species of mammals within the State is adapted for a different set of conditions. What favors one may work against the other. When the numbers of one species increase, the numbers of others must perforce go down. And this is the dilemma of the snowshoe.

In Canada the relative abundance of many predators is directly related to the population cycles of the snowshoes. When rabbits are plentiful, this is reflected in the fur returns for lynx, fisher, marten and fox. But when rabbit numbers fall, the effects are far reaching, as the fortunes of these animals rise and fall with those of the snowshoe hare. These fluctuations are also reflected in the price of milady's furs.

Snowshoes are prolific animals, as well they have to be to escape the forces allied against them. Breeding starts in the early spring and continues until fall. The young number 2 to as many as 8 with 3 or 4 being most common. The gestation period is longer than that of the cottontail, from 36 to 47 days, and the young as a result are further developed at birth. Although somewhat wobbly on their feet for the first few weeks, snowshoes are born covered with fur and with their eyes open. If the female bothers to make one, the nest is a makeshift affair lined with fur which she plucks from her body. The nest may be concealed in a stump, grass clump or hollow log. Snowshoes may have 2 to 3 litters per year. Bucks can be furious fighters among themselves during breeding season, often with fatal results. One look at those efficient hind claws mounted on those equally efficient big hind feet is enough to convince anybody that they would be capable of inflicting considerable damage under the proper circumstances.

Snowshoes are most active from dusk to dawn preferring to spend the day concealed in the underbrush. Occasionally they get downright playful with one another and have sham battles or play "tag in the moonlight."

Snowshoes, like most rabbits, are stay-at-homes content to spend their entire lives within the confines of a few familiar acres. Because of this, and of their specialized habitat, snowshoes will not readily re-establish themselves in an area where they have become extinct, without deliberate restocking by man. Stocking of many species—like the cottontail, is rarely worthwhile, but the releasing of snowshoes in selected areas where conditions seem right to support them has every promise of success.

This big white rabbit is one of Pennsylvania's grandest small game species and one well worth fostering. It has been a part of Penn's Woods since the Ice Age and adds a touch of the far North to a region where the southern opossum has become many times more abundant.

Subspecies in Pennsylvania: Lepus americanus virginianus (Harlan).

Range: In suitable habitat throughout the State—absent from the southwestern and southeastern corners.

CHIPMUNK — *Tamias striatus*

Other names: Grinny; chippie, hackee; chipping squirrel.

Fussy, fleet and frisky, the nervous, bright-eyed little chipmunk is the dynamo of the rodent world. Insatiably curious, yet wary in the extreme, he is a familiar sight in Pennsylvania for a few months of the year. The lovely glory of his distinctive color pattern sets him aside from all other mammals of our State. Chirps and stripes are his distinguishing features and they do indeed make an indelible impression. The chipmunk

is the springtime and the fall—the gaiety of a garden wall—the rustle of leaves—and all the joy of a vigorous life.

The scientific name, *Tamias striatus,* describes the chipmunk perfectly—*Tamias* (a steward, one who stores and looks after provisions) and *striatus* (striped).

The chipmunk is a small ground squirrel, 9 to 10 inches in total length, of which 3½ to 4 inches is tail. Its average weight is 3 ounces. The head is rather short and the prominent ears are rounded and flattened; the tail is well haired and flattened. The over-all color of the back and sides is a grizzled rusty-red to reddish brown, but clearest and brightest on the rump. Dominating the whole picture, however, are the very dark stripes, five in number, which traverse the back and sides. The narrowest runs down the center of the back, while on each side from shoulder to rump, are two very dark brown stripes separated by a cream stripe. The underparts are whitish. No other mammal in the State, with the possible exception of the skunk, has such distinctive markings.

The eastern chipmunk is present in every county of our State, but it varies in abundance from place to place and from time to time. The best place to look for this animal is in open woodlands with plenty of stumps and logs; stone walls bordering wooded pasturelands and city parks that are not too "cultivated." If a forest is dense and dark and the understory very heavy, do not look for chipmunks there. It would also not be profitable to look for them in a true swamp or very wet marsh.

This small ground squirrel spends a good portion of the year underground, and to that end digs extensive burrow systems. These burrows are often intricate, with many side passages which may extend distances of 30 feet or more. There may be several openings to the outside, but it is extremely difficult to find an entrance with a pile of dirt at an opening. For many years the mystery of how chipmunks dug burrows without throwing out quantities of dirt remained unsolved. Then a careful observer watched one dig a burrow and discovered that the animal did push out a large pile of dirt as it dug. But when the burrow was completed to the animal's satisfaction it emerged from a hole which it dug from the inside out! It had apparently plugged the original hole from the inside and then proceeded to make other exits and entranceways from the inside out. The original opening, with its pile of debris, was soon covered by leaves and grass and shortly vanished. These burrows are often made under short or medium height grass and the entranceways may be found at the base of a large, old tree where the root system is raised above the ground. Or an entrance may be found at the base of a stone wall or in the middle of a grass plot. If one excavates a burrow one will find, somewhere deep inside, a large bulky nest—12 by 18 inches is not uncommon—and in this nest the chipmunk sleeps and bears its young. A side tunnel usually serves as the lavatory and thus the nest and main tunnel remain undefiled.

About mid-February, or later, depending upon the weather, *Tamias* emerges from the burrow and makes a few exploratory trips. As spring thaws occur more frequently and the earth gradually warms up, life begins anew for the chipmunks. About the end of March the breeding season is in full swing and approximately 31 days later, late in April or early May, a litter of 3 to 5 young will be born, naked, blind, almost shapeless and completely helpless. Nearly 35 days will pass before the eyes will open, but in the meantime the little bodies will fur out and the distinctive stripes, which were visible even on the bare skin, will stand out clearly. In another month the young will be about half-grown and able to leave the nest and forage with their mother. It is believed that only one litter per year is produced, although there is ample evidence that some young are born late in August. The explanation for this may lie in the fact that some females do not breed in the spring, but are able to do so later in the summer.

It is quite obvious that the eyesight of the chipmunk must be very good and that it depends upon it for protection to a certain extent. During the months when they are above ground they invariably select a stump, rock, log or some elevated position for a feeding station. In areas where they cannot obtain raised feeding stations they simply do not exist. To test the manner in which a chipmunk relies on its eyesight, watch one quietly for some time as it goes about its daily chores. Then move, or make a squeaking noise with the lips against the back of the hand. Usually the little squirrel will stop what it is doing immediately and sit straight up, looking around intently. If the disturbance continues and it cannot ascertain the source, it will scamper off to the nearest entrance to its burrow. But as soon as the tail disappears underground the head will reappear and bright eyes will peer out of the hole. If then one remains quiet, after a few minutes the chipmunk will cautiously emerge and eventually resume its activity.

There is scarcely anything that is so much a part of springtime and fall as the call of the chipmunk. Like the coyote of the West, they seem to enjoy singing in chorus, and their whistling chirps, slurred off almost to a trill, ring clear and high during the bright days of spring and fall. Often one "chuck" will be heard, followed by a brief silence, then another "chuck" and another and another until the sound vibrates through the air. Sometimes the sound is quite different. The rapid chirping noise, about three notes per second is accompanied by a violent jerking of the tail with each chirp. This is apparently a scolding technique and is used when another animal intrudes on its domain. Finally, this vocal squirrel uses, with a high degree of effectiveness, a sharp, single, whistle —an alarm note which sends all other chipmunks within earshot scurrying for their burrows.

The food utilized by chipmunks covers a wide range and is surprisingly varied. This list includes: hazel nuts, wild black cherry, may-apple

pods, small fungi, snails, blackberries, elderberries, choke-cherries, hickory-nuts, weed seeds, maple seeds, slugs, june beetles, trillium seeds, red raspberries, strawberries, seeds from the berries of False Solomon's Seal, swallow-tail butterflies, pods of the wild mustard, seeds from the mulbery tree, cucumber tree fruits, juneberry tree fruits, buckeye seeds, the slimy salamander, dobson flies and small snakes. It is also known that they will stoop to cannibalism and that they are not adverse to an occasional small bird or a tulip bulb from the garden.

The food which can be stored for wintertime or early spring, is handled in two ways. It is either carried into the burrow and stored in a storage tunnel, or it may be buried as a cache away from the burrow. Sometimes when it is taken to the burrow it is stored directly under the nest, which elevates the nest almost to the ceiling of the burrow. As times passes and the food supply is utilized, the nest gradually descends to the floor. If the chipmunk decides to make a cache away from the burrow it transports a large supply of food to a spot where it has excavated a small hole. When this is filled, it carefully covers the midden and even replaces the disturbed leaves or grass meticulously. It is extremely difficult to find the spot where it has been working, even though the observer has been close at hand throughout the process.

The transportation of food by this animal is both simple and amazing. It has two large internal cheek pouches into which the food is carefully stuffed and thus carried from place to place. The squirrel uses its forepaws to maneuver the food into the pouches. It is always careful to balance the load properly and never fails to load both sides as it goes along. When it unloads the pouches it uses the forepaws externally, shoving and pushing upwards so that the food can be taken into the mouth and then dropped into the cache.

The chipmunk is a fairly good climber but it does not do it with the ease and dexterity of the tree squirrels. That does not prevent it, however, from climbing as high as 60 feet in a tree, although by preference it seldom goes above 20 feet while in search of food. It descends the tree head first, in squirrel-like leaps, but much more cautiously than its larger cousins. One is not likely to find it out on a thin branch or twig, nor will one see it make a leap from tree to tree. Fundamentally, the chipmunk is a *ground* squirrel and tree-top living is not for him.

It appears likely that a single individual spends the greater portion of its life within an area not greater than one acre, and for the most part, confines its activities to a circle about 100 feet in diameter. Chipmunks are not particularly sociable creatures but neither are they very aggressive. If an alien chipmunk approaches too close to a feeding station, there will usually be a brief skirmish and the intruder will be driven off without bloodshed. Sometimes the defender has to repeat his actions several times but the feud is soon over.

The chipmunk is definitely a diurnal animal and goes abroad only during the daylight hours. As a result, its foes are primarily those animals which are also diurnal, such as large snakes (which can enter burrows easily), hawks, foxes, bobcats, housecats, and worst of all, weasels. The weasel can and does pursue chipmunks into burrows and has been known to wipe out a whole family in the nest within a few minutes. Although snakes and weasels could also be dangerous at night, there is some good evidence to indicate that the chipmunk plugs its burrow when it retires to its nest to sleep and thus alleviates that danger. Bot flies and chiggers plague this little squirrel.

Economically, the chipmunk seldom interferes with man's interest, and people seem to enjoy watching chipmunks, so a workable "live and let live" policy is generally the order of the day. Should the chipmunk become a nuisance it is relatively easy to catch in a rat trap baited with peanut butter and bacon or some similar bait.

By the end of October or early November, depending upon the severity of the weather, *Tamias* goes underground not to emerge until the first warm, spring-like breeze makes itself felt in February or early March. It is customarily said that this animal "hibernates," but there is some reason to suppose that it may not be a true hibernator. For one thing, before it goes underground it does not take on a layer of fat, as do the other hibernators. It is also known that it has a large supply of food in its burrow and this supply diminishes during the winter months. Therefore, some observers feel that the chipmunk has a modified type of hibernation, but this is interrupted when hunger arouses the animal. Presumably, it taps its available food supply and then goes to sleep again.

During the extremely hot weather of July and August the chipmunk population seems to disappear almost entirely. It would seem that *Tamias* is allergic to extremely hot weather and finds the coolness of underground burrows the equivalent of a vacation "in the mountains" or "at the seashore." This mid-summer sleep has been termed estivation.

Subspecies in Pennsylvania: Tamias striatus lysteri (Richardson).

Range: Northern part of State and southward in the mountains to West Virginia.

Tamias striatus fisheri A. H. Howell.

Range: Southwestern and southeastern parts of State.

WOODCHUCK — *Marmota monax*

Other names: Chuck; ground-hog; whistle-pig; marmot; red monk.

The woodchuck is a paradoxical mammal in its relationship to human economy. Many farmers dislike it intensely for the damage it does to their crops or pastures. But hunters like it for the sport it provides

throughout the warmer months of the year, and many like to eat the flesh of this animal. Unfortunately, its hide has no value. The woodchuck has other values, though. Its burrows provide much-needed escape hatches for rabbits, skunks, opossums and a varied assortment of other animals which seek refuge in the spacious tunnels and den-sites. In an over-grazed pasture or over-worked cropland, the woodchuck dens provide drainage for the soil and a reservoir for benign rains. It is a pacifist at heart and lives only to enjoy the pleasures of life—eating, sitting in the sun or sleeping the deep sleep of hibernation during the intolerable winds and snows of the northern winters.

If you wish to see a woodchuck and you are a city-dweller, take a brief drive to the country in the early morning or late afternoon of almost any relatively pleasant day between spring and fall. Watch the berms alongside the road or gaze into open fields and pastures as you drive slowly along. At first, if you are not trained as a hunter or observer, you may only get an impression that something scuttled from the road to the ditch and vanished, or that some sort of animal or statue is posed, motionless, in the field beside the road.

If this occurs in Pennsylvania, it is reasonably safe to assume that you have just seen your first woodchuck in the wild! If it is possible for you to park your car safely and wait quietly for awhile, you will probably be rewarded by a better view of your quarry. The figure in the field will relax, drop to all fours and proceed to move about the field in search of food; or the "something" that scuttled into the ditch may emerge on the top of the bank, pause for a moment and sit up to look about, then drop down and go off to pursue his business.

Recognition signs are easy. The woodchuck is a mammal about 2 feet long, grizzled brown, chunky, blunt-faced, and sporting a cockade of a tail about 6 inches long. In weight it averages 6 to 10 pounds, but occasionally extremely fat or large specimens weigh as much as 12 to 14 pounds. From the dubious vantage of the highway driver, two impressions of the animal emerge—he is either a poser or a scuttler. Like a squirrel, the chuck characteristically sits upon its hind legs and placidly gazes at the landscape. Or, if alarmed, it has a habit of moving rapidly away, almost flattened to the ground, its tail straight out behind and its legs almost invisible under the fur mat. With familiarity, however, and a trained eye, other characteristics emerge. For instance, it is not uncommon to find a woodchuck basking in the sun, either flattened out on a log or lying along the low branch of a comfortable tree. Or one may stumble upon a really hungry animal, busily making its way to a food supply, and energetically nosing about in search of "green pastures." At such times it gives the impression of being just what it is—a robust, large rodent, bear-like in its chubbiness, intent on the good things of life.

The clincher, so far as identification is concerned, is the immaculate, white "Bugs Bunny" type of front teeth. In all of our other large rodents

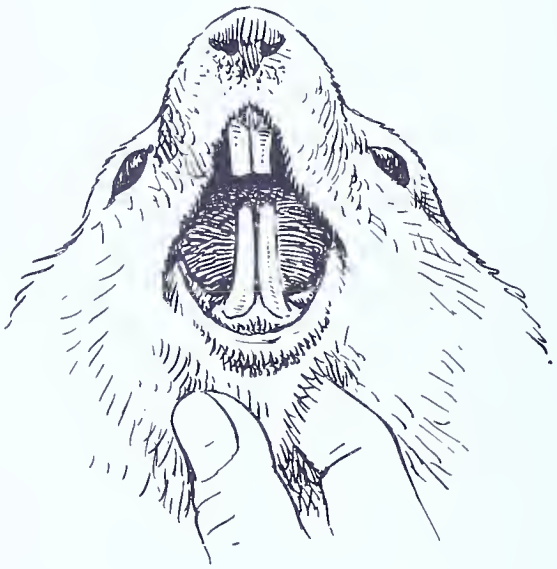
THE WOODCHUCK is termed both a "good guy" and a "bad guy" by man. The former dislikes him for the holes he burrows in his fields, but the sportsmen love him for the fine hunting he provides.

these incisors are either yellow or bright orange. To be sure, the white front teeth are not discernible at a distance, but at close range, or with a dead animal at hand, they can be readily seen.

The woodchuck has thrived on civilization. All indications are that while the mammal was common when Pennsylvania was a primeval forest, it was not nearly as abundant as it is at the present time. As our forests fell before the onslaught of civilization, open fields, meadows

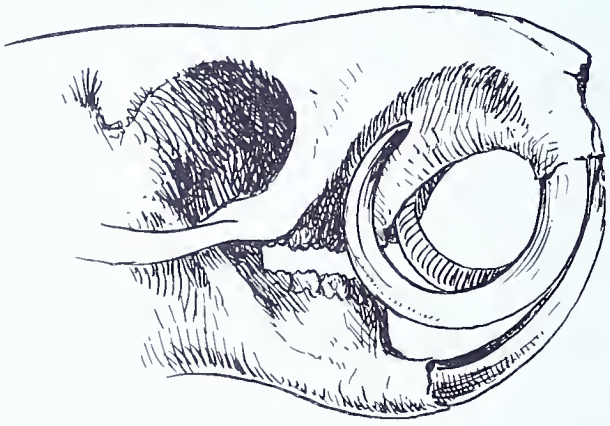
and pastures replaced the deep woods, and whole new, highly favorable living areas were provided for the energetic rodent. As croplands and green pastures multiplied, so did its tribe increase. Man, the woodchuck discovered, can be a good provider and, in the matter of green vegetables, their tastes are quite similar. It goes without saying that the farmer hardly appreciates this similarity in taste!

Look for the ground-hog where the grasses are green, clovers abundant, alfalfa available, a corn-field nearby, an orchard convenient, or a truck garden within easy reach. Don't bother to search a field of poverty grass—there is no percentage in a chuck living there. Brushy fencerows and young woods are favored residential areas. The deep, dark, virgin woods are not popular, but occasionally, an old solitary



ABOVE-NORMAL INCISOR TEETH OF GROUND-HOG. LONGEST MEASURE $\frac{7}{8}$"

BELOW-ABNORMAL DEVELOPMENT OF TEETH



member of the species makes its burrow there and lives the life of a hermit.

It is clear, then, that the woodchuck is a vegetarian primarily, herbivorous, if you will, and that greens make up a large portion of its diet. In the spring dandelions are a favored delicacy and in the fall apples and pears are eagerly sought. Corn in the milk and sprouting beans, peas and early vegetables also provide temptations beyond resistance, and the hard-working farmer can hardly be blamed for starting all-out war against the marauders.

The terms "woodchuck" and "digging" are practically synonymous. If there is one thing in which this animal excels, it is in the art of making holes. Little chucks make small holes and big chucks make big holes and all those in between do their share. They do not dig for sheer pleasure, however, and the holes are merely a part of the burrow system. At the main entrance there is always a mound of dirt which is constantly renewed by debris from within. On this mound the woodchuck frequently sits to look about. From the entranceway the burrow goes down at a rather steep angle, then abruptly levels off into a narrower tunnel. There are usually many side tunnels, or blind pockets, possibly utilized as hibernating cells or sanitary quarters. In addition to the main entranceway, there are commonly 1 to 3 back entranceways. These are not easily discernible for there are no mounds to mark them and tall grass often conceals them. In rare instances, there may be as many as 5 extra exits or entries.

This rodent is ideally adapted for digging, for it has powerful forelegs and heavy claws, and its large, white incisors enable it to cut through relatively thick roots as it makes its way underground. A whole, simple burrow system can be completed in one day. The depth of the burrows depends on the type of soil encountered and, naturally, the deepest systems are in the most porous soils.

The nest is rather small for such a large animal—approximately 15 inches in diameter and about half that high. They are usually located fairly close to the surface, at a depth of 1 to 2 feet, and are lined with nearest available material. Dry grasses seem to be favored but dry leaves are sometimes utilized with the grasses.

One of the surest signs of spring in rural communities is the commencement of house-cleaning activities by woodchucks. For awhile there is feverish activity and new piles of earth appear at the mouths of every occupied burrow. Breeding takes place in February, and the gestation period is approximately 4 weeks. Between the first of April and early May the young are born, and there are usually 3 or 4 in the litter, although 5 is not uncommon. At birth the young weigh about an ounce, are blind and naked and utterly helpless. They remain in the nest until about 4 weeks of age, when their eyes open, and by this time they are

ready to feed on grass and other vegetation. By early July the young are ready to leave home and establish their own burrows. Only one litter is produced per year.

Like most rodents, the groundhog is capable of producing a variety of sounds. The one most commonly associated with this animal is the whistle or alarm call, which it most often utters just before plunging to safety down its burrow. If cornered, it is a fearless animal and will advance toward the enemy, chattering its teeth and uttering a low growl. Another characteristic sound is a "chuck-chuck" sort of noise, made while it is rummaging about in search of food, or communicating with other members of its tribe. Those who have kept them in captivity report that, when stroked or when requesting attention, they make a soft, purring noise which would not normally be heard in the wild.

Hibernation is another characteristic of the woodchuck. When the first severe frost arrives, this rodent retires to its burrow, picks out a suitable side-tunnel, curls into a ball, and sleeps the death-like sleep of hibernation until late February or early March. During the summer and early fall, rolls of fat are accumulated, and when the time comes for the winter sleep the chuck is a sleek, roly-poly bundle of fur. No food is stored in the burrows and only its personal fat sustains it until the following spring, when it emerges a much slimmer and more vigorous individual. "Ground-hog Day," the second of February, supposedly heralds the first emergence of this creature. At this time they are expected to predict the weather to come, either by casting a shadow or not casting a shadow! If the shadow is cast, 6 more weeks of winter can be expected; if the shadow is not cast, all is well for the beginning of a pleasant spring. It is quite obvious that very few woodchucks know what is expected of them, for it is a rare individual indeed who emerges that early in February.

The presence of ground-hogs can sometimes be recognized by well-defined "marking" trees. Such a tree, alive or dead, large or small, will be located near a trail through the grass or weeds or near much-used paths between dens. The trunks of the trees are chewed and clawed as high as the groundhog can reach and the bark fragments lie on the ground where they fall. The actual purpose behind this custom is unknown.

About the only enemies this large rodent has, at least as adults, are man, the red fox, and dogs. Only the young individuals are taken by large owls or hawks. Parasites do not seem to be a serious menace. A good many individuals suffer from malocclusion, or improper growth of the incisor teeth, however. Failure of the incisors to meet sometimes permits one of the teeth to curve around to the extent where it penetrates the skull cavity and kills the animal. The incisors of rodents never stop growing!

On the whole, the woodchuck is of real economic importance to man. As an agricultural pest, it needs to be controlled. As a target for sportsmen, it is a real challenge, and a good game animal. To its credit may be granted its burrows which aid in the irrigation of the soil and provide refuges for all sorts of other animals. The complete disappearance of this mammal would be a most serious loss to this State, in spite of its obvious shortcomings in farming areas.

Subspecies in Pennsylvania: Marmota monax monax (Linnaeus).
Range: Throughout the State except in the Northeastern corner.

Marmota monax rufescens. A. H. Howell.
Range: Northeastern corner of the State.

THIRTEEN-LINED GROUND SQUIRREL *Citellus tridecemlineatus*

Other names: Ground squirrel; gopher; striped ground squirrel; 13-lined spermophile.

Hidden away in a few small colonies located in Venango and Mercer counties in the northwestern section of Pennsylvania, live some most amazing little ground squirrels. To those who have to live with them they are "pests," but to the naturalist they are particularly interesting in view of the fact that they are an "introduced form" which has thrived over the years, but failed to spread to any appreciable degree. Sad experience has shown that most introduced animals, if they manage to survive at all, thrive and spread with amazing rapidity, often driving out the more desirable native forms. The thirteen-lined ground squirrel seems to be an exception to the general rule and does very well in the isolation of a few well-chosen colonies.

The original range of this squirrel was the Great Plains and prairie regions of central United States and southern Canada. There it inhabited the rank, grass-grown prairies. With the disappearance of the tall grass prairies, it has had to seek other, but similar, open types of habitation, such as pastures, golf courses and cemeteries. Where is does occur it is abundant and colonial, but highways, poison and the relentless war of man against "varmints" continue to decimate the ranks of the ubiquitous "picket pin."

At a distance, one might mistake this ground squirrel for an unusually tall and slender chipmunk, but a closer inspection will readily reveal the difference. This is no ordinary animal—this is an elaborately costumed squirrel, sporting a gaily colored coat of fawn and blackish-brown, with a pattern of stripes and dots. In other words, look for a ground squirrel approximately 11 inches long, with a slightly bushy tail about 4 inches long, which it holds horizontally as it runs. The animal will be sporting

a strawish-colored coat and a dark, thirteen-lined blanket on its back and sides. Alternately, the dark stripes are broken by pale spots along their length. This latter is a most casual description, but it should convey the over-all picture. Its scientific name tells the story quite adequately—*Citellus tridecemlineatus,* which means thirteen-lined ground squirrel.

One may very well ask how this "outlander" came to live in the fields of Pennsylvania. In this case, the question is not difficult to answer, and most of the facts in the case are fairly well-known. It is the old, old story of human nature—when we travel and see something strange, we like to bring it home as "exhibit A," whether it be an animate or an inanimate object. The best account of the introduction of *Citellus tridecemlineatus* is contained in a letter to the Pennsylvania Board of Game Commissioners, dated September 2, 1934, from Mr. O. A. Perschka. He says, ". . . the original stock of these pests came from the Rocky Mountain section and was brought into Polk, Pa., by a man by the name of Campbell some fifteen years ago [about 1919]. He liberated at that time just one pair and they sure have done well. The State School Grounds at Polk, Venango County are just littered with holes made by these pests; they are also very destructive to crops especially in planting time as they will eat an entire row of corn just after it has been planted. Their holes are very seldom over 10 inches in depth and not over 6 or 8 feet long. At places they will have the entire territory honey-combed with holes. They have a very sharp pointed head like a chipmunk and are very fast on foot. I tried to run one down, but it just made a monkey of me. The largest one that I have seen was the size of a small grey squirrel."

So that, presumably, was the way the whole thing started. In 1949, eleven colonies were reported, all of them small and at least one of them (on the site of the airport 2 miles west of Franklin, Venango County) probably on the verge of being eliminated by grading activities. The largest and best known colony has persisted on the grounds of the State School at Polk in Venango County and on nearby farms.

Although this rodent makes numerous burrows, they are not easily found. They are usually concealed by vegetation, seldom have any dirt in front of the entrance-ways and are barely 2 inches in diameter. They may be mistaken for the runways of meadow-mice, for the entrance-ways are extraordinarily small in comparison to the size of the occupants. However, these burrows go almost straight down for 6 inches or more, then angle off and proceed from there. The system of burrows becomes a veritable labyrinth of many galleries with many entranceways and the greater portion of the tunnels are only 3 or 4 inches below the sod. The nesting burrows are also labyrinths, but deeper than the first type. The nest, lined with fine, dry grass, is located in a large, comfortable chamber, about 9 inches in diameter.

The young are born in the early part of June, after a gestation period of 28 days. At birth they are naked, blind, helpless and pink, about 2 inches long with a half-inch tail. The litter averages about 9 young, but may vary from 7 to 14 and there is but one brood per year. Apparently for a rodent, they develop rather slowly and it is 20 days before they are covered with hair and over 30 days before their eyes open. By the middle of July they are half grown and can emerge from the burrow, but it is not until September that they are fully grown and ready to fend for themselves. The explanation for the longer period of maternal care and slow development of the young may be correlated with the very long period of winter hibernation. As a result of the long hibernation there is time for only one brood per year, but *more* time to devote to the single brood.

This animal is strictly a sun-worshipper, and rarely emerges from the burrow until the sun is high and the earth is warm. About 9 or 10 o'clock in the morning they wander forth, but long before sunset they are back in their tunnels. Damp, dark days have no appeal for them. As a matter of fact, one will rarely see a striped squirrel on a gloomy day. When the first chill days of September or early October arrive, they hasten to their burrows, plug up the entranceways and curl up for a long winter's sleep, not emerging until the warmth of late March or early April calls them forth. Thus, their period of hibernation is unusually long—6 or 7 months. Only the remaining 5 or 6 months of the year give them an opportunity to breed, reproduce, feed and raise their young, and that is an inordinate amount of work to accomplish in a very short year!

Of all the Pennsylvania squirels this one is the greatest meat lover, although it is really omnivorous. Its diet consists of seeds, insects, roots, berries and small animals—such as meadow mice—that it can capture. It is not above cannibalism, and is commonly seen on the mid-western highway, calmly munching away on a road-killed brother. *Citellus* has capacious, internal cheek pouches which it uses diligently to convey seeds to secret hiding places throughout its season of activity. There is no indication that it eats during hibernation, so the food which it stores may, perhaps, be utilized during periods of bad weather, or when food is scarce. An interesting fact which we have learned is that the animal never attempts to store food which will spoil! The cheek pouches are used to transport dry fodder, while meat and similar food stuffs are consumed on the spot. Certainly a wise procedure.

So far as is known, the thirteen-lined ground squirrel does not drink water. Moisture from the food which it eats seems to supply all the necessary liquid that its system craves, and naturalists who have observed them for long periods in captivity confirm these findings. Even when the heat is extreme, and the animals are confined to cages, they will not accept water as long as they have adequate food.

The voice of *Citellus* is distinctly bird-like in quality. One of the most characteristic calls is a short, sharp, whistle of alarm. Frequently the animal can be seen sitting bolt upright, its tiny forepaws tucked tightly to its chest, looking for all the world like the old-fashioned wooden pin that was once used for picketing horses and mules. In this position the animal seems to quiver in every fiber, alert for possible danger. Suddenly it will drop to all fours, utter its shrill alarm call, sharply jerking its tail with each call, as it dashes madly for its nearest burrow and safety. If cornered, or annoyed by a competitive squirrel, a prolonged, quavering note of defiance rings across the grasslands. But when love comes, or the joy of living abounds, a long trilling whistle, or birdlike chirrup, bubbles over the landscape. The nervous energy of the ground squirrel is readily revealed in its voice.

The thirteen-lined ground squirrel has numerous enemies, among the worst of which are weasels and black snakes, which have little difficulty in pursuing them into their burrows. Foxes and hawks also take their toll, as well as other kinds of snakes. Man, as usual, is the most deadly enemy, for *Citellus* can be extremely destructive to food crops, such as wheat, oats and corn. It is difficult for a farmer to appreciate the aeration of the soil through burrow systems when a crop is completely ruined by the benefactor!

Fortunately, or unfortunately as the case may be, it is not difficult to control these rodents. They may be trapped easily in large rat traps or in live traps baited with rolled oats. Gas in their burrows, poisoned grains and shooting have all been used successfully in control programs.

Subspecies in Pennsylvania: *Citellus tridecemlineatus tridecemlineatus* (Mitchell).

Range: Known only from Venango and Mercer Counties.

GRAY SQUIRREL — *Sciurus carolinensis*

Other names: Cat squirrel, black squirrel, bannertail.

If the sportsmen of Pennsylvania should ever decide to hold a contest to determine which mammal is the most popular small game species, the gray squirrel would certainly rank among the top three. The omnipresent rabbit would undoubtedly win, but the squirrel would not be far behind. In good years, well over a million squirels have been harvested by Pennsylvania hunters.

The generic name for this mammal—*Sciurus*—means "shade-tailed," a very apt description, for when it is in full coat it carries a most magnificent, flat, bushy tail which it uses in all manner of ways. It makes an effective sunshade when it is carefully bent up over its back, with the tip daintily curled back on itself. It makes an excellent counterbalance when its owner flattens himself out on a thin branch and it makes a truly wonderful punctuation point when the squirrel wishes to express

itself with emphasis. With every sharp, staccatic bark it utters, its banner jerks violently, but as its anger or excitement cools the motion of the tail decreases! The rest of the scientific name, *carolinensis,* is geographic in character. It tells us that this animal was described from Carolina.

For those who might not recognize the gray squirrel instantly, it is a rather large, slim, tree-climbing animal, about 18 inches long. About 8½ inches of this is tail. The average weight is 1 to 1½ pounds. The head is rounded and so are the fairly large ears. The predominant color of the upper parts is gray, although rust-red and black hairs often mingle with the gray. The underparts are usually clear white or tinged with yellow. The tail hairs are yellowish at the base, banded with black and tipped with white.

Interestingly, however, the gray squirrel may also be a black squirrel! In the northern part of the State black may be more common than gray locally. All shades of variation occur between the two colors. A single litter may contain a very gray specimen and a very black specimen, with the rest of the young highly variable. In the southern half of its range, a squirrel with a black coat is a rarity. It is also not uncommon to find an albino squirrel—all white with pink eyes, nose and ears. The matter of color in this species is an interesting one. Heredity and genetics play their part, but diet, climate or a host of other things may also be contributing factors.

When Pennsylvania was first settled, the abundance of gray squirrels amazed our forefathers. The State was rich in forests and the woods teemed with squirrels. At intervals huge migrations took place and

literally thousands of squirrels marched through the woods, ignoring all obstacles in their desire to get from "here to there." Thousands drowned in the rivers that blocked their path but until the mysterious urge burned itself out the hordes pushed forward. When the migration was over the countryside behind was almost devoid of gray squirrels, but no evidence of over-population cropped up elsewhere. No one appears to be able to explain just why they travel and where they go.

Lack of food does not appear to be the whole cause, although a failure of the forest nut crop may be the main reason at times. Over-population might be another cause.

These migrations still occur sporadically, but the number of migrants is far, far less. Following the Civil War, Pennsylvania's forests were logged with reckless abandon and the squirrels disappeared with the vanishing woodlands. Between 1900 and 1915, it was feared that they might become extinct over much of their old range. Fortunately, a new era of conservation halted the destruction and the regrowth of the woods saved a vanishing species.

The hunter knows the gray squirrel as a shy and wary animal with an uncanny habit of vanishing just at the wrong time. They are less noisy than the red squirrel and when pursued they become silent shadows. They will flatten themselves against an upper branch of a tree and as the hunter approaches, they will quietly inch around until they are out of sight. Or, they will duck quickly into a cavity in the main trunk of the tree. They are agile, sleek creatures and flash from tree to tree in great leaps, seldom missing their footing.

The gray squirrel prefers the deciduous forest, where oaks, beeches and hickories abound. Here it finds—in good years—all the food it needs and ample protection for its family. Nuts and large seeds form an important portion of its diet—acorns, hickory nuts, walnuts and butternuts. In the spring and summer the diet is more varied—fruits and berries (such as dogwood and viburnum), mushrooms, tree seeds (particularly elms and maples), even larvae and cocoons of insects. Really delightful spring morsels seem to be the buds of elm, oak and sugar maples. When food is readily available, the gray squirrel makes a leaf nest in a handy tree and camps out. This leaf nest is usually built high up, 30 to 50 feet or more above the ground. It is formed by taking twigs and fresh leaves, packing them close together to form a platform and then using odds and ends of fine stuff, such as grass, moss, fresh and dead leaves and bark to make a big, loose nest, about 16 inches

across and 12 inches from floor to ceiling. When it has exhausted the local food supply it vacates its campsite and moves on to another.

A tree den is the normal site of the nursery. This den is usually in a cavity of a tree but, if a man-made wooden bird house happens to be in the vicinity, it is not at all uncommon for a squirrel to pre-empt it. In the southern half of its range, young have been seen in every month of the year, although the vast majority are born in the late winter and spring. Late February through April is the normal time for the first litter. Usually another litter is born in July or August. The gestation period is about 44 days, and the average number of young is 4 to 5. When born the young are completely helpless with tightly closed eyes. Fully 5 weeks elapse before the eyes open and it is 2 months at least before they can get out of the nest and attempt to move around the home tree. The female provides the food and defense. These squirrels are slow in reaching full size and weight, apparently requiring about 2 years. But they may breed when only a year old. The indications are that in the wild they may have a maximum life span of 10 years, or slightly longer.

The gray squirrel is most active during the first and last hours of daylight—a fact which hunters utilize to the fullest extent. Although not as noisy as the red squirrel, they are by no means silent animals. Their sharp, single syllable bark proclaims their annoyance or alarm to the world. The woods fairly ring with it at times. At other times they indulge in a long, drawn out, descending call, loud at first but diminishing in volume as it descends. Again, when they are apparently talking among themselves, the note is a light chuckle and may be almost musical in tone.

The gray squirrel has many enemies, although it is not an easy victim. Cooper's hawk, barred and horned owls, foxes, bobcats and tree-climbing snakes take their share of inexperienced young squirrels.

Subspecies in Pennsylvania: Sciurus carolinensis pennsylvanicus Ord.

Range: Throughout the State.

FOX SQUIRREL ***Sciurus niger***

Other names: none.

Of all the squirrels which inhabit the Pennsylvania woods, none is so spectacular as the lordly fox squirrel. It is truly the king of the squirrels —large, brilliantly colored and quietly impressive. Unlike its slim, trim cousin, the gray squirrel, it does not stick to the shelter and protection of the deep woods, nor seek its food in the relative safety of early morning and early evening. For it pastured woodlots, harboring a few big trees, or the edge of deep woods, with open fields beyond, are its chosen dwelling, and much of its time is spent either on the ground or on a convenient fence rail.

Compared to the gray squirrel, it is heavy and slow, and its progress through the trees is not exceptionally graceful. But it is very wary and knows well when to keep its mouth shut. When pursued it will bypass many trees in order to reach its own den tree, running at a surprisingly rapid speed across the ground (approximately 11 miles per hour). When it reaches its tree, it will climb it rapidly, without a sound, flattening itself against the trunk on the side opposite to its pursuer, and, if successful will soon disappear into its den cavity. However, its propensity for foraging on the ground, far away from the safety of its den, is often its undoing.

When the early settlers came to Pennsylvania the fox squirrel was here, but apparently not in anything like the same abundance as the gray. East of the Susquehanna River a large, very gray form occurred, while in the southcentral and southwestern portions of the State there was a very pale form, which still survives in limited numbers. These native fox squirrels, however, rapidly disappeared before the onslaught of civilization and the guns of our forefathers and it was only by a lucky chance that any survived. The brilliant western form, *Sciurus niger rufiventer,* was found in western Pennsylvania along the Ohio border. During the past thirty years introductions of the western form have been made in practically every county of the State, but the results have been disappointing in many instances.

The western fox squirrel is a chunky, brilliantly colored fellow. About 21 inches is the average total length, with the tail occupying about 9½ inches of this length. The weight of an adult specimen in good condition comes close to 2 pounds, but there have been many cases where large animals have gone over 2 pounds. There is a great deal of variation in color, but a typical animal may be said to be tawny-brown, grizzled with gray above, and pale rufous or yellowish-brown below. The tail is mixed with black and tawny rufous—the underparts usually being tawny-red.

There can be no mistaking a typical fox squirrel for a gray squirrel, once the two have been seen side by side. Because many gray squirrels have a lot of rusty coloration on their sides and tails, it is a common belief that the fox and gray squirrel interbreed. Such is not the case, however, and attempts to induce them to do so have failed completely. A good look at the two animals will soon show that the colors which have appeared similar when the two were apart, are really not in the least like.

As has been said above, the fox squirrel is not a creature of the deep woods. Its chosen habitat is the half-open stand, often surrounded by a pasture, and, if a wooden fence surrounds the area, so much the better. The top rail of the fence makes an ideal feeding station, observation post, or freeway. A gnarled old patriarchal oak with a good hollow center, dominating the pasture, provides a castle fortress for the squirrel and to this den it will always retreat in times of stress. Its favorite time of the

day is the period when the sun is high and for hours it will forage, bury nuts or just plain laze in the sun, according to the time of year or its state of bodily contentment.

The food of the fox squirrel includes almost all the nuts and seeds of the trees within its domain—black cherry, hickory, oak, walnut, beech, elm, basswood, maple, ash, chestnut and conifers. During the season of abundance the squirrel makes a temporary nest or shelf—a rough platform not too high above the ground, consisting of twigs and sticks, without a roof. From this platform it descends to the ground for foraging, and when it is weary or hungry returns to the shelf for a bite to eat and a nap. A more substantial type of nest may be built high up in a tree.

FOX SQUIRREL

This nest will be supported by a foundation of many joining branches, and will have a roof and self-closing door of bark. These nests are in the nature of "campsites" and provide one night stands for the fluid population.

When the corn is in the tassel—and should a field be within his range—the fox squirrel is in seventh heaven. He, and all his family, rush to the land of milk and honey and indulge in an unrestrained orgy. Not only do they eat the corn on the stalks, but gnaw off whole ears which they carry to a convenient fence rail or platform nest, there to eat at their leisure. The husk is stripped off, the kernel is pulled out with the teeth and all the soft parts are eaten. If the kernel is ripe, only the germ will be extracted and the rest discarded. At this time the fox squirrel gives no thought to a future supply of food. These are the halcyon days and life is good! When the feasting ends, work is resumed.

It has been estimated that one squirrel may bury thousands of nuts, each in an individual hiding place. How these myriads of nuts are found again in the lean, hungry days of late winter or early spring is not known precisely, but it would seem that memory and smell play equally large roles. Spring brings a new day and the bursting buds invite another feast, while, as season follows season, berries and fruits supplement the diet. Once in a while, the fox squirrel acquires a taste for meat, or perhaps hunger drives him on, and birds, eggs or nestling birds may be added to the long list of food items. This trait is by no means common in the species, however, and is not generally held against it.

The fox squirrel never really hibernates, in the true sense of the word, but it has a most convenient ability to "hole up" when the weather is too bad. If it has a good layer of fat and is in all-around good physical condition, the most severe weather holds no terror for it. It simply retreats to its den in the tree, curls in a tight ball, and sleeps until the weather moderates, whether it be for a day or close to a week. A truly admirable solution to the problems of winter weather!

In January the urge to mate dominates all other instincts. The male selects his female and pursues her up and down a tree for hours, all the while giving voice to a low gutteral utterance, far-removed from his customary bark. There is much evidence to indicate that a male mates with only one female and that they remain paired for the year—perhaps even for life. In late February or early March, 2 to 4 young are born (although as many as 7 have been recorded). The young are blind, naked, helpless and undeveloped and remain in the nest until they are approximately 6 weeks old. They feed, during this period, exclusively on milk, and their diet changes only when they are able to venture from the nest. Mother and family remain together for a little more than a month after the young leave the nest. Apparently only one litter is raised per year.

While the fox squirrel is more silent by nature than the gray squirrel, it does have several different means of expression. It can give rise to a hoarse bark, a chucking call, a low growl of anger, and a guttural singing song of love.

Because of its size the fox squirrel has few enemies, although the young may occasionally be taken by a hawk, an owl, a fox or a foraging house cat. These squirrels thrive near civilization, and a cemetery, a college campus or a park will prove attractive homes to them. They seem to be the easiest of our squirrels to tame (with the exception of the flying squirrels) and have been known to live as long as 10 years in captivity.

In our State this kingly squirrel provides good hunting, and is certainly a splendid aesthetic addition to Penn's Woods.

Subspecies in Pennsylvania: Only two subspecies of the fox squirrel are known to occur in this State at the present time, and the first is very rare, if not now extinct: *Sciurus niger vulpinus* Gmelin.

Range: Eastern United States west to the Blue Mountains (of Pennsylvania).

Sciurus niger rufiventer: É. Goeffroy Saint-Hilaire, the introduced western form.

Range: Western edge of the State.

RED SQUIRREL — *Tamiasciurus hudsonicus*

Other names: Chickaree; pine squirrel.

Alert, brimming over with energy, raucous, and usually just out of gun-range, the little red squirrel is the "crow" of the mammal world. Its reputation is slightly unsavory, although perhaps based on a false set of standards. There is no doubt about the fact that it is the "busybody" and "gossip" of the woods, and a great source of annoyance to the hunter who would stalk the woods unnoticed. Like its counterpart in the bird world, it loudly proclaims every intruder or unusual event that comes within its ken. What is more, it seems to make it a point to know all that goes on within its domain.

The woodland rings with its shrill scolding as one walks beneath the canopy of leaves, and the self-appointed custodian of the woods darts nervously up and down the trunk of a tree or peers warily from an overhanging limb. It is difficult to get a really good look at this quixotic little imp, but it is certainly not difficult to hear him! At times it seems to be scolding like a querulous old crone; at other times it sounds like an irate foreman, cussing out its crew; then, again, it chirps like a bird, or whistles loud and clear. Its vocabulary is extensive and varied—far superior in that respect to its bigger cousins, the gray and fox. In short, it is the "dead end kid" of the woods.

The red squirrel, *Tamiasciurus hudsonicus,* has an exceptionally long name for such a small tree squirrel, for it is only about half the size of the gray squirrel. But its name is extremely interesting if analyzed. *Tamias* is the generic name of the chipmunk, and *Sciurus* is the generic name of the gray and fox squirrel, so by combining the two names an impression of size is given—a chipmunk-sized squirrel! This is not literally true, however, for the red squirrel is somewhat larger than a chipmunk. There is another interesting implication inherent in the name, though. *Tamias* means "steward" or "dispenser," referring to the habit of squirrels of storing up nuts for future use. *Sciurus* literally means "shade-tail," referring of course to the squirrel's habit of using their broad flat tails in the manner of parasols. At this point, imagination may run riot. A picture of a self-important little red nabob emerges, squatting on its haunches on a little grassy knoll in the deep forest, under the shade of its built-on umbrella, dispensing largess to its less-provident subjects!

Commonly known as the pine squirrel, or chickaree, this rodent is approximately 12½ inches in total length, with a tail, including the hair fringe, just 1/7th shorter than the head and body. In weight it averages 5.44 ounces, which makes it a slim, trim member of the lightweight division. Its boundless energy keeps it pared down, and it is rare that one finds a red squirrel with a roll of fat. Its coloring is distinctive, and varies decidedly from summer to winter. In winter it sports a coat that is rusty red from the top of the head to the tail, with olive-gray on the

sides, lightly sprinkled with black; the ears are tufted with dusky hairs —a unique characteristic of this squirrel; the tail is rufous yellowish above, the hairs banded near the tips with black and fringed with pale yellowish rufous; the underside of the tail is a yellowish gray, banded and fringed much as above; the top has a broad subterminal bar of black. The underpart of the body is grayish white, the hairs slaty at the base and tipped with black. In summer the coat changes to a pale, rusty red, brighter on the outer sides of the legs and feet; it shows a narrow, black, lateral line, ears without tufts and a tail which is less buffy than in winter, but colored much the same. The underparts are clear white.

Although a well-known and common mammal, the personal life and habits of the chickaree are not at all well-known. For instance, there is much difference of opinion regarding the number of litters an individual has per year. There seems to be little argument about the fact that the breeding season begins in late winter and that young are commonly born in April, May or June. The gestation period, or pregnancy, lasts approximately 40 days, and 3 to 6 young are born in a litter. The young are naked and helpless at birth, about 4½ inches long, with eyes tightly closed. They develop more rapidly than ground squirrels, and at less than a month they have acquired the characteristic markings of the adult. The eyes open on the 27th day and the young are weaned when less than 5 weeks old. Often, however, the female squirrel keeps her brood together for a lengthy training period, and family groups will frequently be seen, with the young almost 2/3 the size of the adults. At this point

the evidence becomes confusing. Observers have frequently noted newborn litters as late as August and September, which has led some to the conclusion that a female will have two litters per year—one in the spring and one in the fall.

The nest in which the young are produced may be one of several types. Frequently it is an ungainly, basketball-size nest of shredded grape bark in the midst of a wild grape tangle; at other times it is a mass of grass and bark, stuffed into a natural cavity of a tree or a deserted woodpecker chamber. The home range of the red squirrel is estimated to be approximately 200 yards in diameter.

A wide range of taste in food is a decided asset to these animals. Perhaps the favorite item of diet is the cut green cone of white pine, but hickory nuts are another favorite. Various types of nuts, berries, the swelling buds of maple and elm, seeds of conifers, many species of fungi, and even an occasional young cottontail, nestling or clutch of eggs, all add variety to the spice of life. In spring they love to slit the bark of maples to suck and nibble on the sweet icicles which form. Like all tree squirrels, during periods of lush food supply they harvest for the leaner times. Unlike gray and fox squirrels, however, they do not bury their treasure singly. The chickaree apparently prefers to establish a definite food cache, and in one particular instance two gallons of hickory nuts were found cached away at the base of an old, hollow hickory.

Unlike his larger cousins, the little red demon spends much of its time on the ground and may even tunnel in the soil. In the winter they have been observed to tunnel in snowbanks, and some of these tunnels could be traced for over 100 feet. They varied in depth from just beneath the surface to two feet below the drifts. When pursued, they will often disappear into cavities in rock piles or holes in the ground, rather than chose one of the myriad of trees in close proximity. One was observed to seek safety in a woodrat burrow under a rock when there were plenty of trees handy. This habit of working about on the ground and running along logs, investigating every inch above and below, has led to their being mistaken for weasels at times. When they are searching the ground or logs, their tails are usually carried straight out behind, and their silhouette then resembles that of the weasel rather than the gray or fox squirrel. Most of their activity is carried on during the daylight hours and they are active throughout the year. It is quite true that extremely cold weather, or an exceptional storm, may drive them to remain sheltered for a few days at a time. During that period they roll up comfortably—a tight little ball, neatly wound up within the long, flat tail.

Like the other squirrels, the chickaree fluctuates in numbers, although at irregular intervals. There will be places where it is locally abundant, but a few miles away, in an equally suitable habitat, it will be scarce or absent. Farmers and sportsmen, when interviewed, will often relate tales of maximum abundance "a few years ago," but go on to remark

that they are rarely seen now. On the other hand, they may say that the animal was unknown in that region 10 years ago but is now common.

One of the most interesting tales related about the red squirrel is that concerning its relationship with the gray squirrel. The little red is constantly accused of pursuing, catching and castrating the gray. Many a person has seen an irate red squirrel pursue a big gray, but there appears to be no record of an actual incident in which a person witnessed the castration of a gray by a red. Apparently, all three species of squirrels can live in harmony, but when they do it would appear that the red plays the part of the poor cousin. It seems to live on the outer fringe of the habitat and takes the least attractive section of the woods for its home. Perhaps that accounts for its querulous nature. It has to be constantly on the alert.

Be that as it may, the woods could not be the same without the loud, shrill, prolonged chatter of the red squirrel, which rolls from trunk to trunk and bounces off the canopy above. Nor would it be the same without his sibilant whistle-like call; or his whirr, which so closely resembles the locusts. Only in the heat of summer, or very late spring, does he fail to sound the alarm when danger stalks the woodland. It is then that the crow becomes the policeman of the woods and fields and the red squirrel can take a vacation.

Red squirrels have many enemies—the larger hawks and owls, foxes, the bobcat, domestic cat, dogs, snakes and the like.

The red squirrel provides little in the way of meat, so it cannot be considered a good game animal, nor is its hide worth anything at all. But it is a wary opponent, and those who believe that it is a nest robber feel justified in shooting it on sight. However, the real damage to beneficial birds may be slight.

Subspecies in Pennsylvania: Tamiasciurus hudsonicus loquax (Bangs).

Range: Throughout the State.

EASTERN FLYING SQUIRREL — *Glaucomys volans*

Other names: none.

It is quite safe to say that many thousands of people live in Pennsylvania without ever recognizing the existence of a flying squirrel. This is rather sad, for this soft little sprite is one of our more charming residents.

The flying squirrel is a member of the family Sciuridae, is closely related to the red, gray and fox squirrels, and is, of course, a rodent. Its body is a little over 5 inches long and the tail, which is flat, rudder-shaped and fully furred, is about 3½ inches long. The head is short, broad and rather snub-nosed, but the eyes are black and luminous and the ears are

rounded and expressive. The fur is luxuriously soft and silky, grayish-buff above, but immaculately white on the underparts of the body. The outstanding recognition point about this mammal, however, is the fur-covered membrane which extends between the wrist and ankle of the foreleg and hindleg. It, too, is dark above and white below, and blends so well with the body that it is barely noticeable when the animal is at rest.

These two membranes are the source of the name "flying" squirrel. "Flying" is a misnomer, however. Rather the term should be "volplaning" squirrel, for in the true sense of the word this animal cannot fly. It can sail downward, covering considerable distances (a flight of over

FLYING SQUIRREL

40 yards has been attributed to it), but it cannot make an upward flight. In other words, it scampers up a tree, runs out on a limb, looks for greener pastures, then leaps, spreading its legs out to the sides, laying the all-important membranes flat, and a miniature sail plane is in action. If the air currents are right and the forest is relatively open, considerable maneuvering can be accomplished. A strong upward draft can cause it to swoop upward momentarily but the end result is always a downward trend. The rudder-like tail, coupled with movements of the limbs, enables the squirrel to turn at right angles from its line of flight and elevate or depress the angle of the glide.

The forest or woodlot is the best place for a flying squirrel to live, particularly if there are plenty of hollow trees or snags for den sites, plenty of vines, small trees and the all-important food-giving sources, such as oak, beech or hickory trees. Many a lumber jack, eliminating a hollow tree, has been surprised by the sudden appearance of 15 or 20 little squirrels as the tree crashed to the ground. They are a sociable group and seem to like "apartment" dwelling. But a few individualists are not above moving into man-made bird houses, and may take up resi-

dence in the attic of a house, if there is a handy tree nearby for a means of access.

Food is no great problem to the flying squirrel under normal conditions, for it has developed a catholicism of taste which includes an assortment of berries, nuts and insects. Hickory nuts and acorns of the white oak are preferred above all else. To the more domesticated members of the clan currants are irresistible and a combination of peanut butter and bacon a delectable morsel. On the gamier side, however, it does have a reputation for sneaking a quiet meal of small birds' eggs, and in captivity it certainly does not turn up its impressive whiskers at the bodies of mice and birds. Trappers, too, report that the flying squirrel makes a nuisance of itself by getting caught in sets most definitely planned for carnivorous furbearers.

The nest of the flying squirrel may be found in stubs, hollow limbs of trees, retreats hollowed out by large woodpeckers, or in tangled grapevines. When built in a tangled vine its nest resembles the leaf nest of a gray squirrel and is often mistaken for one. There is no set pattern to the construction of the nest, but it is frequently composed of a large ball of leaves (about a foot or less in diameter) bound together by strips of bark.

In late February or early March the breeding season is in its height and, after a gestation period of approximately 40 days, the young are born—2 to 6 to a litter. The young are very undeveloped at birth, blind and naked, but even at this stage they show the characteristic "flying" membrane or lateral fold of skin. After 4 weeks their eyes are open and it is not long before it is difficult to distinguish between parents and young. It is believed by some authorities that another litter is produced either in July or August.

These squirrels do not hibernate in the true sense of the word and are active throughout the year. However, if a prolonged cold spell occurs, they may become temporarily inactive. Groups of them may form snug balls for mutual protection and warmth in hollow stumps or trees and there remain huddled for several weeks.

Although seldom seen, this squirrel is by no means uncommon. It occurs in almost every county of the State. It is active only at dusk and throughout the hours of darkness—a nocturnal wanderer—well-adapted for night life with its large, luminous eyes. Apparently it is subject to somewhat "cyclic" fluctuations in population, being very abundant in a locality for a number of years, becoming exceedingly rare in the same locality for a year or so, then increasing again. This may be caused by good and bad "mast" (acorns, beechnuts, etc.) years. The cycles are not well-defined, and many factors may enter into the picture.

The enemies of *Glaucomys* are many and varied, for they include most of the large predatory mammals such as foxes, weasels and cats

THE FLYING SQUIRREL is misnamed. It doesn't really fly, but glides in a downward direction. The two membranes between wrists and ankles of the foreleg and hindeg are the apparatus which gives the flying squirrels their ability to glide.

and a number of rapacious birds, such as owls and hawks. Fortunately for this nocturnal pilot, man does not consider him a serious nuisance and seldom wages war against him.

As pets these mammals are gentle, confiding and easy to wean away from the wild. It may be difficult to induce them to forsake their night-life for the drab monotony of daylight activity, but in time it can be done. In captivity, at least, they are long-lived and one was known to reach the ripe old age of eleven.

Subspecies in Pennsylvania: Glaucomys volans volans (Linnaues).

Range: Throughout the State.

NORTHERN FLYING SQUIRREL — *Glaucomys sabrinus*

Other names: Mearns flying squirrel, Canadian flying squirrel.

Larger and heavier than the dainty little eastern flying squirrel, *Glaucomys sabrinus* limits its dwelling to the northern part of Pennsylvania and a path southward along the Allegheny Mountain range. It is something of a "hill-billy" in its liking for the high country. Scientifically speaking, it confines itself to the Canadian Life Zone, which is simply another way of saying that it likes cool temperatures. There are a few places in Pennsylvania where the ranges of the flying cousins appear to overlap, but a distribution map does not indicate many such places.

It is not always easy to distinguish such close cousins in the mammal world, and certainly a quick glimpse in the dusk of one of these nocturnal wanderers would provide little opportunity for accurate recognition. Basically, their color patterns are very similar, but the northern form is brighter in color, decidedly larger, heavier and more robust. Even the flattened tail is heavier and broader. The base of the belly hairs is a blue-gray in the adult Mearn's squirrel and white in the adult eastern species. This can be seen by blowing gently into the fur. This test is not infallible, for young animals of both species often show this blue wash. Size, then, for adult animals is the most reliable external point of differentiation, and it is possible to confuse young *sabrinus* with adult *volans*. Certain skull characters enable the specialist to make positive identification.

A series of weights for adult squirrels of each type showed that the smaller species averaged 52 to 69 grams and the larger species averaged 74 to 125 grams. When the largest *volans* is compared to the smallest *sabrinus,* the difference turns out to be only $\frac{1}{10}$ of an ounce.

Little is known of the life story of this squirrel but it is assumed its way of life is probably similar to that of the smaller form. It is thought that the breeding season comes a bit later, perhaps in March rather

than February. Another brood may come in late August. The number of young varies from 2 to 6 and the gestation (or pregnancy) lasts about 40 days. The babies are naked, helpless and blind at birth, but rapidly grow into stalwart young fliers.

Like other squirrels, the cousins *Glaucomys* are a vocal lot at times. When surprised or pleased they make a "chuck-chuck" sound; when annoyed they indulge in a sharp, quick squeak. Once in a while they have been heard to emit a clear, musical note. They probably have a much wider range of vocal talents, but their nocturnal habits make it difficult to learn about them.

As has been indicated, little is known about the northern flying squirrel. It is presumed that it likes the same sort of food and that its other habits are similar to those of the eastern *Glaucomys*. Certainly the dearth of information about this mammal indicates a fertile field for investigation.

Subspecies in Pennsylvania: Glaucomys sabrinus macrotis (Mearns).

Range: Northern Pennsylvania and southward in the mountains.

BEAVER — *Castor canadensis*

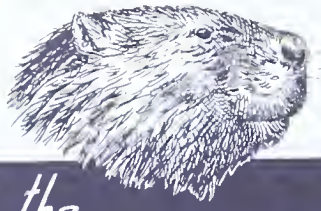
Other names: No other in common use.

Perhaps no other animal has had so much written about it—both fact and fancy—than has the beaver. And there is no happier tale to be told in the annals of Pennsylvania's wildlife management than that of *Castor canadensis*.

One of the largest rodents in the world, a full-grown beaver will weigh from 40 to 60 pounds. Authentic weights of 70 to 80 pounds are known, while there are stories of old, fat ones reaching 100 and 110 pounds.

On land, the beaver is one of the most awkward and impossible looking of animals. The size of an English bulldog, the beaver is built on exactly the opposite plan. The bulldog has a tremendous head and shoulders, but narrow hips, while the beaver has disproportionately large hindquarters and a small chest and forelegs. The head of a beaver is small for the size of the body, but its skull is built like the Rock of Gibraltar to provide strong attachments for the powerful gnawing teeth and their accompanying muscles.

The eyes and ears are small, set rather high on the head and the upper lip is long. This, plus the prominent front teeth, conspire to give the beaver an exceedingly odd expression. The rugged gnawing incisors, two above and two below grow continuously and are covered with bright orange enamel on their outer face. The forepaws are almost



the BEAVER at HOME

AH! THAT
FEELS BETTER

UM-M-M - GOOD

A FEW MORE BITES
THEN - TIMBER-R-R-R!!

BRINGING IN
THE GROCERIES

NED SMITH

human-like in their dexterity and are armed with sharp digging claws, almost an inch in length. The hind feet are tremendous in comparison—6 to 7 inches long, with toes fully and deeply webbed like those of a goose. The hind claws are more nail-like. The second claw is double and beavers have been seen combing their fur and even picking their teeth with it.

There is no mistaking the unique tail. Flat, and covered with soft black scales, it is broadly oval in shape. This wonderfully versatile organ, 9 to 10 inches long, 5 to 6 inches wide, is as indispensable to the aquatic beaver as diving planes are to the submarine. When this waddling, roman-nosed monstrosity enters the water, it loses all trace of awkwardness. And when we observe how it lives and see the results of its engineering prowess in terms of dams, canals, lodges, fallen timber and beaver ponds, we can't help but admire it. We might change our minds, however, if like the citizens of the Cumberland Valley, we were to have our telephone service disrupted for 24 hours by two trees neatly felled across the wires by "eager" beaver.

Fantasy and legend have been interwoven into the tale of the beaver and much has been attributed to him which simply is not true. This is understandable, however, because even the facts in the life history of this amazing rodent are enough to make us believe almost anything of the beaver.

The history and legend surrounding the beaver does not concern itself solely with its life history. This animal, more than any other, led men forward into wilderness America. Beaver was the wealth of early America. Because of this wonderful fur, new ways of life were born; Indians and whites alike spent generations in pursuit of beaver pelts. The famous mountain men of the Rockies were, first and foremost, beaver trappers. Many of the well-known explorers of the early West followed in the footsteps of beaver trappers.

Hats (men's hats) were behind the insatiable demand for beaver fur. Beaver is an excellent felting fur and as long as fashion dictated that the civilized male must wear a felt hat—a "Beaver"—the far corners of a continent were ransacked to fill the demand. Today, beaver is a woman's fur, and it is truly a royal one. But if one were to compare a beaver coat with a beaver pelt, he would see little resemblance. The rippling, plush, finished fur has been sheared off of all the long, brown guard hairs that normally cover the underfur. It's this dense, extremely fine fur that traps insulating air in its meshes, repels water and keeps out the chill of winter.

The presence of the beaver in Pennsylvania is a monument to good conservation efforts. It was one of the first mammals to become extinct during the pioneering of Penn's Woods. Long before a single white man had settled within our borders, Indians trapped the animals and bartered with those crazy white men who were willing to trade knives

and axes and kettles, lead, powder and beads, for its pelt. When the first permanent settlements were made in Potter County about the middle of the 19th century, when elk, wolves, mountain lions, fisher, marten and towering stands of virgin timber survived as yet intact, the beaver was gone.

In the summer of 1917 a pair of beavers, a gift from the state of Wisconsin, was released on East Cowley Run near Sizerville in Cameron County. By the summer of 1922, five years later, all of the streams in southern McKean and most of Cameron County were well stocked with beaver, all presumably descendants of the original pair. In 1921, three beavers from the original dam were trapped and released in Clinton County. This was such an unqualified success that four pairs were purchased in 1919, 24 pairs in 1920, and six pairs in 1922, from Algonquin Park, Canada. These, plus an additional 12 pairs purchased in 1924 from the state of New York, furnished the nucleus of the present Pennsylvania beaver population.

Given complete protection and turned loose in a land rich in permanent streams and pole timber, beaver soon spread through almost every one of the State's 67 counties. Damage claims began to come in, and it soon became apparent that the beaver, far from being a pampered species, was in need of a little management to keep it within bounds.

A total of 6,455 beavers were legally trapped during the first open season in 1934. And, during the next 10 years, over $152,760 worth of beavers were taken in Penn's Woods. An average of 3,000 to 4,000 are now harvested annually. Trapping is carefully controlled; individual bag limits are low and trapping methods are prescribed. This is because beaver, unlike a fox or a coon, has no trap sense whatsoever. This big, naive rodent could easily be annihilated in a few short years if trapping was not closely supervised. Tear a section of the dam out, put a trap in the break, and you have your beaver. But it is illegal to place a trap within 25 feet of a beaver dam or lodge.

Most of the mammals of Pennsylvania leave little sign of their presence. A few tracks in the snow, a nibbled carrot patch, a browse line, or a pawprint in the mud—subtle signs. But the presence of a beaver colony is rarely a thing of doubt. The beaver can and will change things around to suit itself and doesn't seem to care who knows it.

First and foremost an aquatic animal, the beaver rarely strays far from water. For such a large animal, it has a very small home range. A pair will be content to spend their entire lives on one section of a stream, providing the food supply holds and they are unmolested. Some dams or lodges are kept in repair generation after generation, and many beaver colonies have been estimated to be hundreds of years old.

Some dams, the culmination of many years' work by many beavers reach heroic proportions. Dams up to eight feet in height and thousands of feet long have been reported. The purpose of a dam is to create an

artificial lake that will provide a place of refuge and raise the water level enough that the lodge and its entrances will be protected. This instinct for damming up anything that flows is sometimes expressed even by caged beavers who may try to dam up a rivulet from a garden hose.

To build a typical dam, small saplings are cut by the animals, dragged into the stream and arranged with trunks pointing upstream. Anchored with mud and stones the brush pile grows until the stream is blocked. At this point the dam is anything but waterproof (even a completed dam rarely is waterproof). Stones, sticks and mud scraped from the bottom of the new pond are added to the structure, until, by sheer bulk, the dam slows up the stream to the point where it ponds. The dam is then extended and heightened until the beaver is satisfied with the dimension of his new home. Such dams are continuously in need of repair. Because they are not completely watertight, enough water works through them so that the stream does not cascade over the tops. In flood times it does so, breaking down the dam as it roars, and routing old man beaver out to effect emergency repairs.

Once the pond is in order, the lodge is completed. These structures may be enlarged through the years to the dimensions of small hills—30 feet in diameter and up to 8 feet high. A lodge may be started on a

THE SPORT OF BEAVER TRAPPING represents a considerable financial sum for those who are successful each winter. Between 3,000 and 4,000 are trapped in Pennsylvania each year.

small natural island or on a mud and stick foundation built by the beavers themselves. Sticks and logs up to 5 or 6 inches in diameter, laid up in a disorderly fashion and chinked with mud or plant debris, form the sides and the roof. The branches are so intermeshed that the lodge is well-nigh impregnable. Inside, a low chamber about 2 feet in height and often 6 feet wide provides living quarters for as many as 8 to 10 beavers throughout the winter months. There may be a single

HIND FOOT
OF BEAVER

entrance or there may be several, but all are underwater and the beaver must dive whenever he wishes to enter or leave. The platform inside the lodge must perforce be wet most of the time, but the beaver is reputed to be a model housekeeper and frequently changes his bedding of grass or plant fibers.

One of the most persistent rumors concerning beaver is that they use their broad tail to transport mud. This is untrue. The mud is always transported clutched close to the chest by the forepaws.

The most conspicuous signs of a beaver are the tree stumps bearing the unmistakable marks of incisors. Soft, fast growing deciduous species, such as aspen, willow or birch are singled out first. A beaver will very rarely cut coniferous species.

As it begins to fell a tree, the beaver stands on its hind legs and balances its weight on its big flat tail. As it starts, big chips up to 6 inches long are gouged out by making two separate cuts and prying out the intervening wood. As the beaver gets deeper, the cuts get smaller so that a beaver-cut stump looks like it had been chopped with an axe. A tree 6 to 8 inches in diameter can be felled in a short time. They exercise no control over how a tree will fall and there are cases known where beavers have been crushed by falling trees.

There is a great flurry of tree cutting in the fall of the year as the animals prepare for winter. The winter food of the beaver consists of the inner bark and, perhaps, some of the wood itself of twigs and logs it has cut and stored in the pond. Branches cut from fallen trees are grasped with forepaws and teeth and dragged down to the pond where they are stored. Logs too big to carry in this fashion are rolled or floated by extensive canal systems. Cut green wood is not particularly buoyant and sinks to the bottom of the pond as more and more branches are piled on top. Six or 7 animals may build a large pile that will last through the winter. Beavers have no particular fear of cold weather, however, and, as long as there is open water, they may cut and drag with deep snow drifts around the pond. This cutting in the snow will sometimes leave stumps standing several feet above the ground.

Beavers do not hibernate, but they lead a life of indolence during the winter, punctuated only by an occasional trip out of the lodge and under the ice to the "woodpile."

Not all beavers build dams or lodges. Those that live along large rivers or deep lakes with earthen banks use streamside burrows that they excavate themselves. Occasionally a beaver colony will have both burrows and lodges and its members can flee to either in time of danger. These burrows, always with an underwater entrance, may go into the bank 10 to 15 feet, curve up above water level, and end in a small chamber often the same dimensions as a lodge chamber and as scrupulously clean.

In addition to dams and lodges, the third great engineering feat of the beaver is its canal system. In low country, canals 3 to 4 feet wide and several feet deep may extend thousands of feet from the pond, always toward a source of new trees. These canals extend the range of an animal which feels insecure when waddling about too far from cover. Canals are also used to ferry logs and branches back to the pond. These canals may be used by generations of beavers who keep them under repair and slowly extend them throughout the years.

Beavers come into this world in May after a 3 month gestation period. A typical litter is 4. The individual kits are well-developed and are born fully furred with open eyes and strong incisors already beginning to erupt. Each weighs almost a pound. Still they are helpless, and can sometimes be heard mewing like little kittens through the lodge walls.

In a month's time they have been weaned and acclimated to a herbivorous diet of grasses, flowering plants and various other pond-side vegetation. At their first appearance outside the lodge, they are the size of muskrats and, unless the broad tail is plainly visible, are easily mistaken for them. The kits will often stay in the home lodge until they become sexually mature, usually in their third year, at which time they leave

the home pond and strike out on their own. During any given winter, a lodge may contain three generations of beavers and average 8 to 10 individuals under ideal circumstances.

One of the well-known traits of the beaver is its habit of slapping its tail hard on the water's surface when frightened. A fountain of water splashes up, a crack like a pistol shot puts the entire colony on the alert, and the beaver is gone. It is perfectly true that beavers take alarm upon hearing this signal, but it is doubtful if the tail slap is actually intended to be a danger signal as such. A frightened beaver will often submerge without leaving a ripple; again he may slap and dive without any apparent provocation even when other beavers are not out. The mighty slap is a diving aid, giving the beaver an extra push to tip its body up for the dive.

Swimming is solely a function of the big hind feet which act in unison to propel the animal for as long as a quarter of a mile under water on a single breath. The tail serves as an indispensable rudder, and keeps

THE FIRST open seoson on beavers in 1934 produced 6,455 hides. During the next 10 yeors over $152,760 worth of beovers were tropped in Penn's Woods.

the animal on an even keel as it swims beneath the surface. The water pressure on the top and bottom surfaces counteracts the powerful thrusts of the hindfeet, which, were the tail not present, would make the animal wobble up and down as well as go forward. The beaver turns by alternate kicks of the hindfeet and deft sculling strokes of its tail.

Despite its relatively small chest capacity a beaver can remain submerged for over 5 minutes with apparent ease, but dives are normally

much shorter. Its eyesight is very poor, but both smell and hearing are acute, so that it is extremely difficult to approach a wild colony without alarming the beaver. They become acclimated to the presence of people readily, however, and, when not persecuted, carry on business as usual despite human activity in the area. An adult beaver has little to fear from any animal, and pond and lodge furnish such complete year-round protection that beaver populations will skyrocket if trapping pressure is lessened appreciably. In 1931, only 14 years after the first beavers were re-introduced in Pennsylvania, there were already over 1,500 known colonies.

Young beaver are subject to predation and occasionally an oldster will be attacked while ashore by a stray dog or a bobcat. Otter have been accused of feeding on beaver—some authors even going so far as to say that this animal is the beaver's worst natural enemy. This is far from the truth. Beaver and otter may live amicably together in the same ponds, neither competing with nor preying upon the other.

Beavers have a curious habit that serves much the same function as the tree-clawing of bears or the urinating posts of dogs and foxes. Beaver will make mud pies in the shallows and then deliberately smear them with castor, a waxy substance that has a curious, but very faint odor. Two sacs, the size of walnuts, lying on either side of the anal opening, produce this material which is apparently attractive to other beavers. These castoria were once used in the perfume industry, but their only use today is in concocting trapping scents.

Beaver are a common sight to those who can get out and enjoy Penn's Woods. Its reestablishment in the State—the reestablishment of the animal that started the settlement of America itself—was a major achievement. But despite its increasing numbers, the sight of an aspen stump with fresh signs of a beaver's teethmarks, or a trout-rippled pool with a beaver dam and lodge, or the sound of a beaver slap, never fails to provide a wilderness thrill than can be equalled in no other way.

Subspecies in Pennsylvania: Originally *Castor canadensis canadensis* Kuhl.

Range: Northern part of State and in isolated colonies in the southwestern part.

Other names: White-footed mouse; vesper mouse; wood mouse, Le Conte white-footed mouse; Canadian deer mouse; cloudland deer mouse; cloudland white-footed mouse; Baird white-footed mouse; prairie deer mouse.

Here is a paradox! To begin with, the deer mouse is one of the most common and abundant mammals in the State, yet it is almost completely unknown to the average citizen. It is native to this State, and yet is readily confused with and likened to the introduced house mouse. If, in urban districts, a white-footed mouse invades a residence, the lady of the house will explain its presence by saying, "Oh yes, in the fall 'field mice' often come indoors to escape the cold." Yet, to a scientist, a "field mouse" is not a *Peromyscus,* but a *Microtus,* which rarely, if ever, enters houses! To make matters more confusing, three subspecies of *Peromyscus maniculatus* are recognized from the State, and yet the differences are so subtle that not even the experts can be absolutely sure of their identifications!

The deer mouse is a handsome and dainty little animal, measuring in total length from 7 to 8 inches, with a tail of 3 to 3.8 inches, and a hind foot of .8 to .9 inches. Thus, it is somewhat larger than the obnoxious, introduced house mouse, which rarely if ever exceeds 6.5 inches in total length. The tail of the house mouse is naked and scaly, while that of the deer mouse is always fully covered with hair. What is more, the deer mouse is conspicuous by its magnificent coloring, for it wears a grayish-brown to brilliant brown top coat and a handsome vest and under-parts of snowy white, as well as four white paws. The piquant little head is adorned with big ears and sensitive whiskers and a twitchy nose. As befits a creature of the night, its eyes are large and luminous. The name "deer" mouse may be derived from either the large ears and eyes or the coat color. Although it has a highly tuned nervous system and is easily frightened, there is nothing skulking or furtive about its actions. Unlike the house mouse, it is scrupulously clean in its feeding and grooming habits, and has never been known to transmit disease to the human race.

The food of this wood mouse consists of the seeds of black cherry, poplar, hemlock, sycamore, maple, birch, black gum, wild grape and others, plus snails, insects, and dead crawfish. When the corn is in the shock it may move into cornfields and take its toll of the harvest, and it often invades corncribs and granaries. Otherwise it does not compete economically with man. Possessing small, but efficient internal cheek pouches, it carries its food to some sheltered spot before consuming it, and leaves piles of seed hulls at middens beneath projecting rocks, logs or about old tree stumps. Since it does not hibernate, but is active through the severest winter weather, it sometimes accumulates enormous caches of seeds to keep it going when supplies run low. When the owner

has taken up residence in a hunting camp or deserted summer cottage these caches may turn up in the most amazing places—empty coffee pots, dresser drawers, old boots, inside mattresses, or within a kitchen range. Their habit of transporting seeds in their cheek pouches results in a certain amount of spillage, and perhaps we can attribute some new forest growth to this little mammal. Incidentally, the scientific name, *Peromyscus,* is from the Greek combining words, meaning "pouch" and "little mouse."

Their home nest is usually placed in a dry spot above ground, such as a log, hollow tree or fence post. But they climb well, and are just as apt to be found in cavities of trees or abandoned squirrel or bird nests, which they remodel and dome over for their own use. The nest may

be constructed of a wide variety of materials, but characteristically it is lined with plant or animal fibre, fur, down, wool, cotton, milkweed, thistledown, or whatever soft "makings" are most readily available. It is quite likely that each animal has more than one nest, and should a nursery nest become foul or damp, the family moves to clean quarters. In shape the nest resembles a big ball of fluff, with a well concealed entrance hole. This ball may measure anywhere from 6 to 12 inches in diameter, depending on the location and the ambition of the individual.

As might be expected, the deer mouse has a high potential rate of reproductivity. There is no indication of year-round breeding, but from

late March until early October the females are kept extremely busy, and as many as 4 litters may be born. There is some indication that there may be a rest period of 4 to 6 weeks in July or August, but on the other hand it is well known that a female may be nursing one litter and be pregnant at the same time. Survey records show that most of the males taken from the latter part of March on are in breeding condition, and females with embryos have been taken from very early April until mid-October. Apparently a female has her first litter, becomes pregnant while still nursing and raises a second litter immediately. Then a rest period follows, and in late summer the same pattern is repeated. The gestation period is three weeks.

A litter, consisting of 3 to 7 young, but usually 5 is born at the end of the pregnancy. The young are pink, naked, blind and helpless at birth, but their growth is extraordinarily rapid. At the end of three weeks they are fully furred, with a soft juvenile coat of blue-gray above, the white underparts revealing the dark basal portion of the belly hair. In color, this juvenile coat is similar to that of the adult house mouse, and it is not unusual for a person to mistake a young deer mouse for an adult house mouse.

By the time the young wood mice are two months old they are undergoing their first moult, and the new coat more closely approaches the beautiful adult coloration. It is still soft and grayish, but the brown dorsal color is making its appearance, and the dark undercoat of the belly hairs is almost completely hidden by the longer, snowy-white hairs. The youngsters are now ready to breed if the season is right, and the whole cycle may start again. By the time the animal is six months old it has acquired its mature pelage, and to all intents and purposes is a fully adult animal. With such rapid rate of growth and early reproductive potentialities it is small wonder that the deer mouse continues to thrive in spite of the astoundingly high mortality rate!

There is some evidence to indicate that the female may exercise territorial rights during the breeding season, driving out intruders when possible. It would seem that their home range is about half an acre, while the adult male probably has a home range of 1 to 1½ acres.

The wood mouse is not a noisy animal, although it can emit a rather wide variety of sounds. The high pitched squeak or squeal of terror, given when the animal is trapped or seized by another mammal, is the noise most commonly heard. In addition, however, they frequently give a chirring sound, particularly when they are sitting on their hind paws and rolling a morsel of food about with their front paws.

Then there are the individuals who sing. This trait is much more common in the house mouse than the wood mouse, but nevertheless it is not unknown in *Peromyscus*. The reason for the singing is a mystery, but once in a while an individual, or several individuals, will raise

their voices in song, albeit the music is thin, high-pitched and birdlike in quality. For some reason, singing in mice is usually associated with a high population density. When the population fluctuates, as it invariably does, and a low is reached, the singing ceases.

Population fluctuations among rodents are well known, although the cause has not yet been defined. Over a period of several years, a particular species of rodent will be abundant or superabundant—then comes the crash and a very low population, followed by another build-up.

In the wild it is probable that the individual deer mouse seldom lives to attain 3 years of age, and it is far more likely that few survive their first year. In captivity, and with good care, individuals have lived to the ripe old age of 5 years or more. They are cleanly little pets, and easy to keep, but because of their nocturnal inclinations they do most of their playing and moving about at night.

This mouse is what is known as a "buffer" species. This means that it serves as a source of food to all sorts of mammals, birds and snakes, and when the deer mice are abundant, more "valuable" species suffer less from predation. In other words, foxes, weasels, snakes, hawks and owls will catch the mice and let the chickens go! So, in a certain sense, perhaps the wood mouse does have some economic value to man. The magnitude of this importance is open to question, but still, except for the occasional invasions of cabins, summer cottages and granaries, the wood mouse has little adverse economic value. One interesting enemy of the deer mouse is the parasite, *Cuterebra,* which is the larvae of the bot fly. Two different species have been taken from this rodent, and during late August and September a single mouse may have as many as 4 larvae. The inguinal region of the host is particularly favored. The host is obviously inconvenienced and uncomfortable while harboring the larvae, but although large holes are left when the warbles emerge, the wounds heal quickly, and apparently little permanent injury results.

Scientists recognize three subspecies of *Peromyscus maniculatus* in Pennsylvania, as well as another species, *Peromyscus leucopus.* Skull and tooth differences make separation possible when the animals are dead, but identification is always difficult.

Peromyscus maniculatus gracilis (Le Conte) is the largest of the *maniculatus* group, and occurs only in the northeastern sector of Pennsylvania. It prefers cool, moist forests, at high elevations throughout its range. It is characterized by a very long tail, sharply bicolored and hairy and usually terminated by a tuft. Although the color may range from brownish gray to a rather bright brown on the back, the pelage is softer and grayer than in *leucopus,* and the ears are larger.

Peromyscus maniculatus nubiterrae Rhoads is slightly smaller than *gracilis,* and it is said that the dorsal stripe is broader and better defined.

It, too, prefers the cold, damp forests of birch and hemlock, as well as cold swamps, and never ventures into open fields or brushy fence-rows.

Peromyscus maniculatus bairdii (Hoy and Kennicott) is the most distinct of the *maniculatus* group, and can be readily recognized by its small size and extremely short tail. The upper parts are brownish-gray, mixed with darker hairs, and the winter coat is somewhat brighter. It is a creature of the open fields, sandbeaches and windswept hillsides. It may be found in the most uninviting looking places—along railroad right-of-ways, in open fields with scarcely any cover, and under driftwood on windy beaches, where no other *Peromyscus* would care to live. In short, it has a definite ecological niche and has remained aloof from other members of the *maniculatus* group. It is, however, a recent pioneer from the west, and formerly was thought to occur only along the beaches of Lake Erie in northwestern Pennsylvania. Now, it has extended its range, as the countryside has opened up, and has invaded Schuylkill County in the southeast and the Susquehanna Valley in the northeast, and has been taken locally throughout the western and central parts of the State.

Subspecies in Pennsylvania: Peromyscus maniculatus bairdii (Hoy and Kennicott)

Range: Probably throughout the state although no specimens have been taken in the densely forested or mountainous sections of north-central Pennsylvania.

Peromyscus maniculatus gracilis (LeConte)

Range: Northeastern corner of the State south at least to Carbon, Monroe and Luzerne Counties.

Peromyscus maniculatus nubiterrae Rhoads

Range: From the southcentral part of the State northward to Potter and Bradford Counties.

WHITE-FOOTED MOUSE — *Peromyscus leucopus*

Other names: Fischer's deer mouse; deer mouse; northern white-footed mouse; wood mouse.

The white-footed mouse *(Peromyscus leucopus)* shares with the short-tailed shrew, the honor of being one of the two most abundant mammals in the State. It occurs in every county, in a wide variety of habitats and at almost every elevation. It looks like, and lives beside, the more specialized *Peromyscus maniculatus* group of deer mice, but it does not interbreed with that species. This is the important fact which entitles it to specific recognition and scientific interest. In taxonomy (classification of animals), the specific name is designed to take care of this situation. So, in Pennsylvania, we have one representative of the *leucopus* group of white-footed mice, and three of the *maniculatus* group.

In general appearance the white-footed mouse is easily confused with the deer mouse described previously. There are a number of differences, however, although they are rather subtle, and the only sure means of identification lies in certain skull and tooth differences. Living specimens of the two forms can usually be distinguished by differences in facial characteristics. The white-footed mouse has a more slender, pointed face than the deer mouse, and its ears and eyes are noticeably larger. The eyeball measures approximately one millimeter larger in diameter, and while this is a very minute difference in measurement, it is quite large in proportion to the size of the eyes involved. This mouse, in its fully adult pelage, is an extremely sleek, brown mammal, with relatively short, fine, glossy hair and snowy underparts. The tail is not sharply bicolored and does not have a tuft on the end, and it is usually considerably shorter than half the total length of the animal. *Leucopus* also has a larger hind foot than the members of the other group.

In almost every respect, the life history of the white-footed mouse parallels that of the deer mouse. Its breeding habits are presumed to be the same, its food requirements are similar, it builds the same type of nests, and its enemies and parasites are identical. The young wear a baby coat of bluish-gray, go through a first moult, and then emerge in the bright adult pelage, even as the young wood mice do.

The white-footed mouse likes wooded and semi-wooded areas, thickets and brushy fence-rows in fact, all terrestrial habitats where overhead cover is present. It is rarely found in fields away from brushy cover, although during the fall months it may invade cornfields for a certain period of time. It is obvious that there are very few places in the State that the white-footed mouse does not find to its liking. The deer mouse, on the other hand, is rather selective in its habitat, and, therefore, has a more restricted range.

Nocturnal and shy though it may be, the deer mouse is surprisingly easily tamed, and when it has taken up residence in a cabin it may readily lose its shyness and even wander about during the daylight hours. One individual was taken in a live trap, then released and observed. Instead of scurrying for cover it immediately got up on top of the cage and sat up, its whiskers and nose twitching. The observer then dropped a cracker crumb and it was quickly seized by the mouse. The trap was baited and reset. By actual count, this same individual entered the trap 16 times in less than 20 minutes, and by the end of that time would crawl into the observer's hand and eat whatever was offered to it. Finally, it was literally so stuffed that it could eat no more and waddled off to a hole in the wall and disappeared. It was easy to recognize this particular individual, for it had a bobbed tail, so it was decided to keep it under

surveillance. Within a few days the mouse was so tame that it made its appearance without hesitation at any time of the day or night. It also became so much of a panhandler that it was worse than a bear in Yellowstone Park! For over a year it was watched, fed and played with, and proved to be a most amusing pet. Then one day it was found dead on the doorstep of the cabin, apparently the victim of a weasel, for it was still warm when found, and the only marks on the body were two tiny puncture wounds at the base of the skull.

Another large female built her nest in an old-fashioned gallon coffee pot, and successfully reared a litter of young, in spite of the fact that the lid of the coffee pot was constantly being lifted to observe the progress of the family!

City-dwellers will seldom encounter this handsome little mouse, for it spends its brief life out in the open, and comes into contact with humans only when it takes up residence in little used cottages or cabins, or invades granaries. Thus, there is little evidence that one of our most common mammals is always with us.

Subspecies in Pennsylvania: Peromyscus leucopus noveboracensis (Fischer).

Range: Throughout the State.

EASTERN WOOD RAT — *Neotoma floridana*

Other names: Cave rat; cliff rat, wood rat; pack rat; Allegheny wood rat; trade rat.

One of the least known, but not uncommon mammals of the Commonwealth, is the handsome Allegheny wood rat. Its western relative has become synonymous with the West and legend, romance and fact have all dramatized the name "pack rat." Many a fictional camp feud has started because a miner lost his false teeth, or a valuable diamond ring, or what-have-you, and blamed his loss on a bosom companion. When the fury and violence has run its course, the lost item is accidentally discovered in a pack rat's nest. Such is fame, and the western pack or trade rat has quite a reputation!

About the tent or cabin of the explorer or camper the pack rat comes to ply his trade, bringing bits of stones and sticks to exchange for bright utensils, bottle tops or buttons. This unequal trade (from the human standpoint) cannot long escape detection, for basic necessities are in short supply in a wilderness economy. The culprit is tracked down, and the westerner comes face to face with a mammal he will never forget.

In the eastern portion of the United States, more specifically, Pennsylvania, the situation is different. Always seeking rugged terrain, our native rat sticks close to rocky outcrops on mountainsides, or to caves, dry ledges and massive sandstone rock slides near the tops of the hills.

By choosing such terrain this mammal automatically avoids contact with the greater portion of the industrial, effete eastern civilization. Since no economic problem arises, there is little necessity for recognizing the presence of the animal.

The wood rat, it should be made clear, is in no way related to the sinister imported black and brown rats. It is a native of our countryside, and was here long before white man despoiled Penn's Woods. The Indians knew the animal well, and utilized its delicate, tasty flesh. It is unfortunate that the name "rat" has been applied to it, for it cannot escape the inevitable correlation of terms.

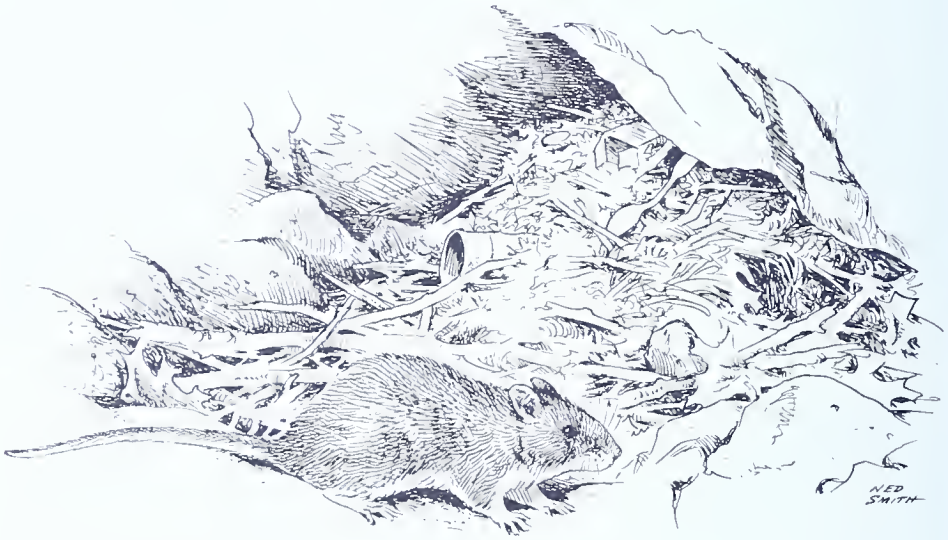
The generic name of the wood rat is *Neotoma,* from the Greek, "Neos," new, and "toma" to cut. The allusion is to the sharp cutting teeth, or incisors, of this rodent; and possibly, to a peculiarity found in the young of this species. At birth the young have incisors which meet in such a way that the edges form a diamond-shape, which enables them to cling to their mother's teats without tearing or damaging her, and yet permitting them to hold on most securely. This condition persists for the first three weeks of their lives, or until the teeth have assumed their normal position.

An adult wood rat weighs just over a pound, is approximately 17 inches in total length, with a furry tail 8 inches long. The large, lustrous eyes betray its nocturnal habits. Big rather naked ears and remarkably long and sensitive whiskers complete its facial adornments. Its coat is buffy gray above, slightly darker in the middle of the back, buffy sides, gray head, white underparts and paws, and occasionally a buffy patch on the breast. The winter coat is darker, softer and longer.

The wood rat is never found at low altitudes, and shuns civilization, although it may establish itself in a hunter's cabin that has been temporarily abandoned. By preference it confines itself to rock ledges, caves and extensive bare patches in the mountainous region. It is a creature of the night and its peak of activity is not reached until the night is half gone, although it may forage from dusk to dawn. It is not uncommon, however, to find a perky little face peaking out from behind a boulder during the day. It does not hibernate, but bad weather, extreme

cold or excessive moisture, may curtail its activities greatly, and it may remain "at home" for several nights.

The presence of this mammal can usually be detected by the bulky nest which it builds on a rock shelf or on the level floor of a cave. These nests are often made of red cedar twigs and lined with shredded bark, but any fine material available is undoubtedly used. The nest is open at the top and is not unlike the nest of many birds. They are cleanly animals and never defile their own dwellings. Their "outhouse"



THE WOOD RAT usually builds its bulky nest on a rock shelf or on the level floor of a cave. The nests are often made of red cedar twigs and lined with shredded bark.

is a common site for the colony, and here they deposit their oval-shaped pellets, which may, in time, actually total several quarts. During their nocturnal wanderings they visit brush and open thickets in search of food, but the foreign matter which they carry back to their nests suggests that they may make extensive journeys to the bottom lands. They have a fondness for building large storage piles of nuts and berries, and seem to have the same haying instinct that the rock rabbits of the western mountains possess. The cave rat has been observed to collect green food, then spread it on the rocks to dry, with the evident intention of curing it. Their diet embraces most of the plants in their domain. Fruits and berries, including those of the dogwood, blackberry, mountain ash, wild cherry and shadbush; the fruits and stalks of pokeweed and sassafras, fungi, ferns, rhododendron and a host of other plants, are favored by them.

Because of their nocturnal habits and the inaccessibility of their habitat, it has been difficult to obtain accurate information about the breeding habits of this animal in the wild. However, observations on captive specimens indicate a gestation period of between 30 and 36 days. A litter of 2 or 3 young are born. These weigh about 15 grams at birth, and are pink and naked. They grow rapidly, and when 25 days of age,

they can almost take care of themselves and begin nibbling on all sorts of solid food. The breeding season continues from early spring until mid-fall, and 2, perhaps 3, broods are raised.

The wood rat has a variety of sound effects, although it is not by nature a noisy animal. When attacked it may emit a shriek of terror, and when "fencing" or "boxing" may give a grunting squeak, a short, sharp squeal, or a low chirp. Occasionally they chitter, click or grate their teeth. They are not gregarious mammals, apparently, and are continually bickering among themselves. They brace themselves on their hind legs, using the tail as a support, and push, scratch or box with the forelegs. At this point, the long, sensitive whiskers fairly vibrate with excitement. Even during courtship there is little love lost between the mates-to-be, and the fur frequently flies during the whirlwind affair. A characteristic mannerism seems to be thumping with one or both hind feet, and the vibrating of the outer third of the tail very rapidly, up and down on the ground. This may be a warning signal, it may be a challenge, or, perhaps, it may be all part of a game!

Although aggressive among its kind, the wood rat is easily tamed and makes a gentle and tractable pet. They rarely attempt to bite, even when first captured, and are so curious and agile they are a delight to watch.

Like most of the rodents, the wood rat has many enemies, notwithstanding its inaccessible habitat. Wildcats, foxes and weasels probably take their toll, and possibly a few of the large snakes. But the great horned owl seems to be the most dangerous enemy.

The fur is soft and fine, but too perishable for use in commerce, and while the flesh is said to be excellent, few there are who will deign to eat an animal known by the name of "rat."

Those hunting, hiking or "caving" through the upper reaches of the Allegheny Mountains should keep a sharp lookout on rocky shelves or the floor of a cave for the tell-tale piles of debris and litter which mark the presence of this obscure trader of the east.

Subspecies in Pennsylvania: *Neotoma floridana magister* Baird.

Range: In suitable habitat throughout the State.

RED-BACKED MOUSE — *Clethrionomys gapperi*

Other names: None.

The red-backed mouse looks much like the common meadow mouse—a small, stocky, shaggy mouse with a tail of medium length (1 to 1½ inches), ears almost hidden in the fur, small, black eyes, a blunt head, and prominent orange front teeth. The only obvious external differences between the two are the color of the fur and the usual choice of a home site.

The top of the head, neck and back are a dark brownish-red, not quite as bright as the red squirrel, but rather unexpected in a mouse. The sides are gray, often with a yellowish cast, which shades imperceptibly into the silver gray of the underparts. The winter coat is a brighter tone than the darker, more intense, summer coat. Occasionally a red-back will be found without the "red," and will be almost indistinguishable from the meadow mouse. There are many differences between the various species of short-tailed mice that unfortunately do not show on the surface, such as tooth pattern, skull and skeletal differences. Until one becomes familiar with the "look" of each, they are confusingly similar.

However, if the mouse is reddish-brown with a dark gray belly, has a tail of medium length and is taken in woodlands (especially in mountain country) then it is almost surely a red-backed mouse.

Red-backs are one of our most common small mammals, but are closely confined to certain types of woodland. This is a mountain mouse, a denizen of the ridge tops, where spring is retarded and winter comes too early for most of us. In forested areas of birch and maple, mixed with spruce or hemlocks or white pine, where logs lie in profusion on a moss and fern floor, or in rocky areas, or around the quaking edge of a cold sphagnum-black spruce bog left over from the last ice age, red-backs may be the most abundant of small mammals.

In such an area their runways may penetrate the soil in all directions, ducking from log to log or wandering off through the loose black forest soils. In rocky areas, or deep among the loose boulders that geologists call talus slopes, they have little use for such runways, but scamper about in underground galleries between the rocks. They often leave their protected runs, however, and forage about the forest floor. In the fall, when the leaves are down and the woods are dry, they can make a startling racket very disturbing to anyone seated on a stump straining his ears for a deer or a squirrel. In years when they are unusually abundant they are much in evidence even during daylight hours.

These mice are true woodsmen and it is a very unusual circumstance that will tempt one to pioneer elsewhere. They have been taken in houses that happened to be built in red-back domain, but are never a real problem in this respect, like the deer mouse or the house mouse. They may occasionally wander a short distance into open country, but never become established there.

No matter what the season, the red-back is a busy little animal. The fat, portly old meadow mouse has only to poke his head out of his grass house and reach for the nearest blade of grass, but the red-back must hustle for a living. During the dead of winter it lives on the little stores of seeds or tubers that it had tucked away the previous autumn, or it may harvest the fronds of some evergreen fern or nibble at a dormant bud. Its list of known food plants reflects its industry; ferns, mosses,

fungi, tuberous roots, tree leaves, acorns, beechnuts, cherry pits, blackberries, raspberries, even picnic lunches. Its diet is as varied as its ingenuity can make it, but is predominantly vegetable matter. This is truly a forest mouse, taking advantage of whatever the woodlands have to offer in the way of food. Red-backs also eat a certain amount of animal matter. Old bones left about the woods, or cast deer antlers, will soon be nibbled away by the calcium-hungry rodents.

Red-backs are prolific breeders. The breeding season extends from February through October, during which time the population may expand from a few veterans which have wintered successfully, into a thriving colony of perhaps hundreds of mice. Four to 5 young make up the average litter. The gestation period seems to be just under 3 weeks (17 to 19 days). The young are not only sexually mature, but often grandparents themselves, during the course of a single summer!

Their home, a grass-lined ball of dead leaves or grass, is usually underground in as secluded a spot as the mouse can find. They are not great burrowers though and seldom actually excavate a den. Instead, they take advantage of the cover offered by tree roots, stumps or rocks. They forage far and wide and have been known to climb trees and bushes.

Red-backs have been caught in the act of trilling a squeaky little song, and several may even join in answering one another. These melodious little outbursts may be the mouse's way of warning off other red-backs. Do they represent a "challenge" or a warning mechanism or do they just sing to work off a little excess energy now and then? Who knows?

Such prolific, active little animals might be expected to have a large number of enemies. These mice have an enemy that lowland rodents are seldom exposed to—the timber rattlesnake. This reptile is adapted for warm-blooded prey only, is amazingly common in some areas and takes a good many red-backs as well as any other mammal small enough and defenseless enough for it to handle. Red-backs form a large part of the diet of many woodland predators and more than one bear has rooted up the woods like a terrier in pursuit of this four-legged morsel. They are not as susceptible to aerial attack as the meadow-inhabiting mice but occasionally are snapped up by an alert hawk or owl.

This is a widepread genus, and one species or another is found all over the northern parts of both the Old World and the New. In Pennsylvania, red-backed mice are not found east of the mountains in the warm, rolling farm country of southeastern Pennsylvaina, nor west of them in the dry, white-oak hills of southwestern Pennsylvania. They are absent from the flat lake country of northwestern Pennsylvania as well, except in a few cold spruce bogs. The cold tamarack forests of the Pymatuning area hold an isolated colony of these mice.

The red-back has a pedigree extending back through thousands of years, a claim that predates that of the Indians. Bones and teeth of this

mouse have been found in direct association with such extinct animals as mastodons, peccaries, and muskoxen in Pennsylvania caves. Some of these caves are located in places which are now too warm and dry to support this mouse. They were obviously cooler and wetter thousands of years ago during the last days of the Pleistocene Ice-Age.

Subspecies in Pennsylvania: Three as follows:

Clethrionomys gapperi gapperi (Vigors).

Range: Northern and central parts of the State.

Clethrionomys gapperi paludicola Doutt.

Range: Northwestern part of State in vicinity of Pymatuning Swamp, Crawford County.

Clethrionomys gapperi rupicola E. L. Poole.

Range: Known only from Berks and Schuylkill Counties.

MEADOW MOUSE — *Microtus pennsylvanicus*

Other names: Field mouse; bull mouse; meadow vole; meadow mole.

Some mammals have little effect on the world about them but the effect of the meadow mouse is much more impressive than the animal itself! The meadow mouse is one of those crucial forms upon which the balance of nature rests.

All life on earth is ultimately dependent upon the plant kingdom for food. Green plants alone are capable of converting solar energy into those chemical substances which make up food. Consequently all food chains must begin somewhere along the line with plants. And it is the unhappy lot of the meadow mouse to be step one in the conversion of grass to flesh.

This small rodent is bread and butter to most of the carnivorous mammals of the State. Hundreds of meadow mice disappear daily down the gullets of hungry mousers, from the least weasel (an animal smaller than the mouse itself) to the black bear.

Should the mouse crop fail, the long chain of adjustments is soon painfully apparent. Small game species are exposed to increased predation by those carnivores which normally prey on mice. The numbers of fur-bearers drop. Birds suffer. The farmer begins to wonder where his chickens are going. That delicate prey-predator balance collapses and a hungry army of flesheaters must either find new sources of food or starve, with dire consequences in either case.

If, on the other hand, the meadow mouse crop were to expand beyond its normal numbers, the results would become even more disastrous. These are field-inhabiting mice, directly competing with agricultural man for the products of those fields. Veritable plagues of mice have

occurred sporadically for centuries in Europe and a few have been recorded in the United States. Populations have built up to fantastic figures estimated at thousands per acre—locust-like hordes of mice eating anything green within sight.

Our meadow mouse, *i. e.* the species, *Microtus pennsylvanicus,* has never been implicated in such plagues and apparently is not as destruc-

FIELD VOLE – REDBACK VOLE AND YELLOWNOSE VOLE ARE SIMILAR EXCEPT FOR COLOR.

tive as other closely related mice, but the potential is there, and the mouse in times of population "highs" is capable of doing considerable damage.

Fortunately it leads a precarious existence, subject to many natural checks such as adverse weather, disease, predation, the need for suitable food and cover and interspecific stress (for which humans have the psychiatrist's couch). Its numbers, although they may fluctuate from year to year, remain more or less in balance. This balance may be tipped, however, by the unforeseen vagaries of both man and nature.

The meadow mouse is a shaggy, brown mouse, about 6 inches in length, with tiny black eyes and short ears almost hidden in the fur. The tail is about 1¾ inches long, or twice the length of the hind foot. This is an important point. Two similar mice (bog lemming and pine mouse) have bobbed tails, about the same length as the hindfoot, while at the other extreme, many species of mice possess long tails. The underparts are gray, occasionally suffused with ochre.

The meadow mouse can be confused with two other Pennsylvania mammals—the rock vole and the red-backed mouse. The rock vole, *Microtus chrotorrhinus,* a very rare mouse indeed, resembles a small, grizzled meadow mouse with a distinct orange nose and cheeks. It is found in a few isolated colonies in the northern part of the State, and prefers rocky, cold, moss-encrusted mountain woodlands to the open field habitat of *Microtus pennsylvanicus.*

The red-backed mouse, *Clethrionomys gapperi,* although confusingly similar to the meadow mouse, can usually be distinguished by a combination of habitat and color. Instead of fields it elects to live in wooded situations, rock slides, cool, damp ravines and moss-choked northern bogs. The two *may* occur together, but not as a rule. The red-back

resembles a small meadow mouse with a rich suffusion of mahogany red down its back. The meadow mouse itself is a grizzled, dead-leaf brown, or if young, may be gray-black, but without any trace of red. Immature, and occasionally adult red-backs, may be confused with young meadow mice. Fortunately every mammal, large or small, has its own peculiar tooth pattern. If it becomes necessary, identifications can easily be made at most museums or universities from the skull alone.

Meadow mice are so common and widespread throughout Pennsylvania that it would be difficult to find a meadow, a grassy swale, or any relatively moist, old-field situation without a resident population. If the grass is spread aside (this must be long grass, not lawn turf) you can usually find a ramifying network of well-trodden, one-lane pathways extending through it. This system of paths is as complicated and as well traveled as our own system of roads. Once established, the mouse will normally spend its entire life within an area the size of a city lot, never venturing far from the safety of its familiar labyrinth. These paths may tunnel beneath the sod, wind about clumps of swamp grass, cross puddles, riddle muskrat lodges, dive beneath boards, old mattresses, criss-cross the firm mud of the tide-water salt marshes or wind through an upland meadow high in the mountains. The floors of these subway systems are kept firm and swept clear of dirt and encroaching vegetation by the mouse; its sides and roof, unless the owner elects to burrow, are of grass.

Somewhere in the maze of tunnelings, the mouse has home base, in the dead heart of a grass clump, under a board or in a shallow excavation occasionally right on the surface of the ground. "Home," a hollow nest of dried grasses the size of a softball, is completely roofed over, like a muskrat lodge in miniature. They will serve the mouse well throughout the coldest of winters, whether he lives in our backyard or in Arctic Alaska.

During the winter, if there is adequate snow or dead vegetation to insulate against the sweep of the winds, nests are built above the frozen earth. Their heat may actually melt little chimneys in the snow as the mice huddle in them. But these nests are gypsy affairs, and if one meets with destruction, its loss is of little consequence to the mouse, who straightway builds another. The meadows, fresh from under a melted snow cover, will be dotted with soggy little surface nests—all deserted.

These mice are active throughout the winter under the brown mat of last year's meadow growth and actively extend their runways under the cover of snow. Safe beneath the snow, they live on natural hay and dormant vegetation. During this season they are much given to girdling berry bushes and fruit trees. If the snows are persistent, girdling may go on unnoticed, and orchard trees may be permanently damaged. When snows are light or lacking and the meadow mouse is forced to live an exposed existence, hungry predators and Old Man Winter take severe toll of the population.

As a result of the cumulative effects of our ever-changing climate, of agricultural practices, of predation by almost every carnivorous bird and mammal big enough to take it, these mice never realize their full reproductive potential in Pennsylvania. Under ideal conditions the meadow mouse undergoes a definite cycle of population density with peaks of abundance spaced at about four-year intervals. The typical picture of such a cycle shows a gradual increase in numbers to a peak, followed by a "crash" or die-off within a few months' time to an extreme low. A gradual build-up renews the cycle again. The die-off is a real phenomenon and, when it occurs, dead meadow mice may be commonly found in the colonies. The reasons behind it have never been fully explained, but much recent research points to diseases that may be "triggered" by physiological changes brought on by the increased tensions of over-crowding.

In actual fact, however, the cycle is rarely allowed to run its course and is usually interrupted in our latitude by any number of things, and

THE HOME of a meadow mouse is a hollow nest of dried grasses the size of a softball and completely roofed over like a muskrat lodge in miniature.

no two colonies of meadow mice are affected in the same way. One may be having its ups, the next one its downs. High waters, droughts, scanty snowfall, torrential storms, long, chilly damp spells, trampling by livestock, invasion by weasels, plowing and cultivation, unusual predation—all these may effect population levels. There are many hidden factors operating as well, factors that influence the populations indirectly but just as surely—plant successions through the years, land use changes, erosion, and other variances. The net effect seems to hold the meadow mouse in balance.

The lifespan of a meadow mouse in a cage may exceed 3 years, but a free-living one is lucky if it survives as many months. That they survive

at all is due to their phenomenal (for a mammal) rate of reproduction. The population turnover is fast and furious and very few of the mice survive from one summer to the next. But, in spite of the odds against them, a colony is capable of rapid recovery under favorable circumstances.

Breeding season starts in early spring as soon as the weather moderates and things turn green again. Litters of 2 or 3, rarely as many as 8 or 9, follow each other at slightly less than monthly intervals. One famous captive meadow mouse produced no less than 17 litters in one year. Females are ready to produce young of their own at 3 weeks of age. This terrifying potential is rarely if ever approached in nature, but litters are produced with monotonous regularity from early spring until late in the fall.

As individuals, these are round-the-clock grass eaters. They are as much a grazing animal as is a horse and their tiny molar teeth are modified in much the same way. Their columnar teeth grow throughout the life of the animal to compensate for the work they perform as little millstones crushing up the harsh grasses. Their diet is primarily grasses, sedges, grass seeds, bark in times of stress, occasionally an odd bit of flesh or bone, roots, apples, melons or other field crops, if a kind providence and an unwilling farmer provide them.

Much has been learned and much remains to be learned about *Microtus pennsylvanicus*. This is a species of great importance in this State—a potential menace from a standpoint of public health and agriculture, a readily available "crop" to be harvested by an army of furbearers, and a "buffer" to prevent undue predation upon the State's valuable wildlife. Here is a mouse that well may be the most important single species of mammal in the State.

Subspecies in Pennsylvania: *Microtus pennsylvanicus pennsylvanicus* (Ord).

Range: Throughout the State.

ROCK VOLE — *Microtus chrotorrhinus*

Other names: Fern vole; yellow nosed vole.

This rare little forest mouse has been taken in but four of Pennsylvania's northeastern counties—Luzerne, Sullivan, Wayne and Wyoming.

From an historical point of view, it's a refugee, an interesting little four-legged anachronism that may be on its way to extinction in Penn-

sylvania; a living reminder of that day, some 10,000 years or so ago, when the ice of the last of the great glaciers began to recede to the north.

Physically, the rock vole resembles the meadow mouse *(Microtus pennsylvanicus)*. It's about the same size (4.5 to 6 inches, including 1.5 to almost 2 inches of tail), same stocky build, short legs, shaggy fur, medium tail, small beady eyes and furry ears; same color fur, brown above shading to gray beneath. But there is one obvious difference. The fur about the nose and cheeks of the rock vole is a most unexpected orange-yellow. No other local mouse is so colored. The shape of the skull and the detailed pattern of the molar teeth show that, despite the close external appearance, the rock vole and the meadow mouse are not too closely related.

Certainly as far as their habits go the two are poles apart. Meadow mice are common in almost every hayfield and grassy swale within our borders. Rock voles live in small colonies in rocky, "northern woodlands," in places filled with a tangle of ferns, moss-covered logs and boulders and shaded by yellow birches . . . often these sites are extremely rocky, with intricate, deep, moist, and cool passageways.

Almost nothing is known of the biology of the rock vole. It is a plant-eater, and presumably its food habits are similar to those of the red-backed mouse *(Clethrionomys gapperi)* which shares its mountain retreats. Its food consists of ferns, seeds, green stems and leaves of locally available grasses and herbs.

It is evidently not as prolific an animal as the meadow mouse, but the amount of information available on its reproduction is deplorably meager. Litters of 3 to 4 young are born from early spring well into the fall. Two Pennsylvania specimens taken in late September had 3 and 5 placental scars respectively. A placental scar is a small scar left on the wall of the uterus when the young are detached at birth. The scars persist for some time and will, with certain qualifications, indicate the number of off-spring a given female has had.

The rock vole is most common in eastern Canada, but manages to linger in isolated little outposts as far south as Tennessee, only by living high in the mountains. That it once did occur in the intervening lowlands, when the climate was colder, is shown by skulls and bones of the rock vole from a cave in southern Bedford County, Pennsylvania, where they do not live today. But it still hangs on precariously in a few favored localities in northern Pennsylvania.

Subspecies in Pennsylvania: Microtus chrotorrhinus chrotorrhinus (Miller).

Range: Found only in the northeastern part of the State.

PINE MOUSE — *Pitymys pinetorum*

Other name: Mole mouse.

Some rodents, the western pocket gopher for example, are so highly adapted for a life underground that they have come to resemble moles in general body form, and are almost as helpless above ground as others would be beneath it.

The pine mouse is actually a sort of meadow mouse, but with variations. What the meadow mouse does above ground the pine mouse carries out under the surface. One may kill a sapling by girdling the stem, the other by stripping the roots. It has several physical characteristics that seem to suit a subterranean life—small eyes, small ears, a torpedo shape to the body, stout feet and claws, and a short, glossy, molelike fur that sheds dirt like a duck's feathers shed water.

The mouse is from 4 to 5 inches in length, a bright shade of chestnut brown shading to yellow-gray on the underparts, short, sleek fur, a large, blunt head, and a *short* (less than one inch) tail. The bog lemming, the only other native mouse with such a short tail has a shallow but distinct groove running down the front of each upper incisor; those of the pine mouse are smooth.

A burrower, but a weak one, its local distribution is governed mostly by the condition and the type of soil. If the soil is too wet, or too stony, or too shallow for burrowing, the pine mouse heads elsewhere. Its subterranean preferences make it almost independent of surface cover and wherever the soil is light and loose its tunnels may extend into places where surface rodents rarely intrude—bare cultivated fields, truck gardens, flower plots, just about anywhere they shouldn't be. Its tunnels may ramify in all directions and anything in the plant line, beneath the ground, may suffer accordingly. They are a very real menace to orchardists at times. Mowing may control the other gnawing mice, but the pine mouse sneaks in under the sod and the first inkling of its presence may be the yellowing leaves of a dying, root-girdled fruit tree.

This is, essentially, a southern species and consequently thrives best in the southern half of the State. East of the mountains in the lowlands of southeastern Pennsylvania they may occur in excessive numbers at times, but in the mountains, or in the plateau country of western Pennsylvania, the pine mouse is local in distribution and generally few in numbers. In these latter areas it is almost exclusively a woodland form, closely confined to areas of deep, sandy soils, the fine-grained friable soils of the creek banks or the river flood plains, or where the forest floor is deep with humus. Burrowing has to be easy or there will be no pine mouse. It avoids dense, clay soils or the glacial gravels of the northern corners of the State.

Despite its basic requirement of the proper soil conditions, this mouse is a great wanderer, for little colonies are scattered hither and yon throughout Penn's Woods wherever conditions suit the animal. They may be plentiful in a sandy spot along some woodland creek but one could trap until doomsday on the hillside above and never catch one.

Beyond the fact that the first specimen of which the scientific world took any note was caught in pine woods, pines and pine mice have absolutely nothing in common. Perhaps mole-mouse would be a better name, but it's too late to change it now—the name has become too ingrained.

The pine mouse has fewer young per litter than the other meadow mice, on the average, but its breeding season is fully as long and its subterranean habits afford it a measure of protection that more than compensates for a slightly lower birth rate. Litters are rarely larger than 4, although 5 or more have been reported. Breeding commences in very early spring, March or early April, and continues well into late fall. The gestation period is approximately 21 days. In about 3 weeks the young are weaned and out on their own.

"Home" is a grass or leaf-lined nest, usually underground, or under some cover such as an old board or a rock. Individuals have a high tolerance for one another and these mice have been found in little colonies all occupying the same burrows, possibly a family group. The diet is almost exclusively plants, a wide variety of them, with a higher percentage of roots, tubers and bulbs (including wild onion). They store food to some extent, and have been reported as feeding on acorns, pokeberries and ground ivy *(Nepata)*. In captivity they readily take a wide variety of vegetables.

Pine mice have their enemies, too. Perhaps most important is Mother Nature herself—floods, droughts, freezing cold, fires, rains, snows, all the vagaries of the weather which affect the populations by influencing the birth rate or the death rate, or producing changes in the land itself that may or may not be favorable. Hawks, owls, foxes, skunks, weasels, opossums, minks, coons, cats, snakes, all occasionally dine on unwary pine mice. And its role as a "buffer species," providing food for hungry predators that might eat more desirable species if pine mice were not available, is about all we can enter on the credit side of the pine mouse ledger.

Uncommon enough in western Pennsylvania to be considered a novelty, common enough in the southeastern section to be a potential agricultural menace, the pine mouse does more damage than its size and its secretive habits might lead one to suspect.

Subspecies in Pennsylvania: Pitymys pinetorum scalopsoides (Audubon and Bachman).

Range: Throughout the State.

MUSKRAT — *Ondatra zibethicus*

Other names: None other in common use.

If you're a duck hunter, a silent canoeist, or a trapper, the muskrat needs little introduction to you. The duck hunter, cramped in his blind, counts the muskrat as one of the minor folk of the cattail world of ducks whose presence helps to pass the time between ducks. The canoeist, if he noses his craft up some watery sedgeway, counts the muskrat as one of the reasons for canoeing—a part of his world of water. The trapper, with cold-numbed fingers, holds up a dripping muskrat and sees, not a muskrat, but a few extra dollars to be spent at Christmas time.

The muskrat is the nation's leading fur animal. The annual crop, in the neighborhood of 20,000,000 pelts, far exceeds in value such aristocratic furs as mink, fur seal, chinchilla or marten. Many of the world's outstanding furs come from aquatic mammals—furs that are deep and dense to protect their owners from the chill of the water. The muskrat has that dense, luxurious combination of rippling underfur and shining guard hairs that enable its pelt to be treated and sheared, dyed and disguised in many different ways. It is one of the most beautiful as well as utilitarian pelts that the furrier has at his command.

Such fur coats have put a price on the muskrat's head and, year in and year out, a small army of men and boys, maybe even a few not-to-be-outdone little sisters, take to the field with traps jangling and hip-boots squishing to "set" for muskrat.

The animal itself resembles a small beaver with a long rat-like tail (8″-12″ long) that is flattened from side to side. Adult muskrats vary from 1½ to 2 feet in overall length. Of some 23,500 muskrats taken from the Blackwater National Wildlife Refuge in Maryland, the largest male weighed an even 4 pounds. Runner-up, a female, was 3 pounds, 12 ounces. But these are exceptional and the average weight of the rats from that same marsh was 2 pounds, 3 ounces. Eyes and ears are well-developed, but small. The limbs are hidden in the body contour. Forefeet are small with well-developed claws for burrowing; the hindfeet are large with fully webbed toes. The scaly tail is naked and black, but the body is densely furred in a dark-brown color, which may vary from chestnut to almost black. Rare white and tan mutations have been reported; the coal black mutation is very common in some regions.

Superficially the muskrat looks and behaves somewhat like a small beaver. But put the skull of a muskrat and a beaver side by side and there is little more than a vague resemblance. They are both rodents but that's as far as it goes. Now put the tiny skull of a meadow mouse beside them. Except for size, the skull of the muskrat and the mouse are almost identical. The muskrat is really a giant field mouse—one of the largest of its kind in the world.

THE AVERAGE MUSKRAT litter consists of six to eight young and each female has two to three litters a year. A month after being born blind, hairless and helpless, they are weaned and are about a third grown.

There are two general types of habitats in which muskrats live and thrive. Both require water. Muskrats reach their peak density in marshland, where the water is unpolluted and vegetation is abundant, and it is here that we see their characteristic beehive lodges. Muskrats are also found, typically, along the banks of streams both large and small throughout the State. If these banks are not too badly trampled by livestock and the soil is fit for easy burrowing, a muskrat or two will sooner or later test it out. Whether they stay and form a permanent colony depends upon many things—water purity, available food, whether or not the watercourse dries up during a part of the year, the size of the stream itself, trapping pressure and general molestation. A slowly meandering stream dreaming its way along, one with overhanging weedgrown banks and a fairly dependable water level through the year, will attract and support muskrats. If it flows through open farmlands, so much the better, for here the banks are usually more overgrown with the grasses and herbs upon which muskrats thrive. A cornfield, a field of clover, or even a flower garden, if they are near the streambank, will usually be investigated and sampled. But muskrats, as a rule, stick as close as they can to their beloved water and interfere with man and his activities only when man invades muskrat domain. Muskrats are a considerable source of damage to canals, riddling the banks with their burrows During the heyday of the Pennsylvania canals, in the early 1800's just prior to the

railroads, the muskrat was considered the most destructive mammal of the State and canal companies paid bounty on them When introduced into Europe in the 19th century, they spread fast and far to become serious pests in the vast canal systems of Germany, France and other countries. Now the muskrat is earning a bad name for itself again, in the domain of the farmpond, whose low earthen dams were not built to withstand it.

The lodge is the most conspicuous and unmistakable evidence of the muskrat. In extensive swampy areas, where burrowing isn't possible, the rats will start in the late summer to prepare for winter. A muskrat lodge is rarely constructed in water over 2 feet deep. The rat begins to pile up any kind of vegetative trash it can find in the immediate area—this usually means cattail stalks—and keeps up until a low platform of soggy vegetation has been raised above water level. Such platforms are usually fitted with a "plunge hole" down which the owner can escape if need be. At this stage such islands often serve as feeding platforms and furnish the foundation for an actual lodge. Continuing the process, a mound of dried vegetation, chinked with muddy algae, pondweeds, and anything else available, will rise above marshlevel. It will be a single chamber, beset with "alcoves" in many cases, where the individual rats can sleep, and scratch, and dream of the cattailed summer. These lodges may reach 8 to 9 feet in diameter and rise 2½ to 3 feet above water level. They represent many long hours of cutting, piling, and shaping.

The muskrat's industry is sometimes appalling to contemplate. Canals, tunnels through the soft mud and decayed vegetation, runways and plunge holes are everywhere. In a muskrat marsh there is rarely a lack of muskrat "sign." The streambank rats are no less busy, and banks will often become so riddled with holes that they collapse and slide under their own weight. Other clues to their presence are the "stream channels" that their continual comings and going will wear into the muddy bottom about their burrows, their droppings, opened mussel shells and the green cuttings of cattails or streamside weeds.

THE MUSKRAT is the nation's leading fur animal. The annual crop, in the neighborhood of 20 million pelts, far exceeds in value such aristocratic furs as mink, fur seal, chinchilla or marten.

Tracks can often be seen in the mud, and the animals themselves may be in evidence, particularly in the early morning or late evening. To catalogue the diet of the muskrat would be to list almost all of the green tender vegetation available in his swampy world. In the marshes, the cattail is the most important single item. The rootstocks, buds, and the young, actively growing stems are eagerly harvested. After the plant has reached maturity in the latter part of the summer, the harsh, tough leaves and stems are no longer palatable. Indeed muskrats are picky eaters, at least during those times when food is plentiful and they can afford the luxury. And much more is harvested and left lying than is actually eaten. At other times, however, during the crisis of a long, cold winter, the rats must subsist on whatever they can dig from the marsh bottom in the way of roots and frozen stalks. The bark of certain trees and limbs may be used, too, in winter. Although primarily plant-eaters, muskrats vary their diet with animal protein. Freshwater clams are eagerly searched out, expertly opened and devoured. Any dead animal, turtle, fish, or even another muskrat, will be eaten, or at least sampled.

This good-sized animal, easy to locate, easy to trap, and with a price

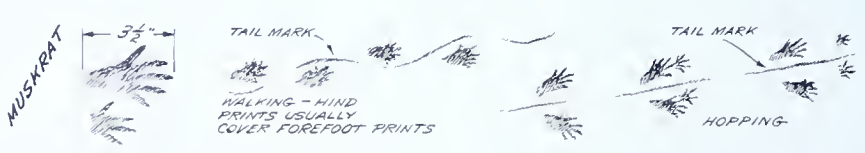
on its head, is harvested by the millions every year. Yet, it holds its own. Despite all of the hazards of life, of drought and flood, of predation by carnivores, of trapping by man, of disease, of weather, of interspecific strife, of dams and drainage, the muskrat is still our most common furbearing animal.

And little wonder, when you consider their reproductive capacity. An average litter of muskrats (the average is an elusive figure that may change from place to place or from year to year) is composed of from 6 to 8 young, although the actual numbers may vary from 1 to 11. Females rarely breed during the year of their birth, but the following season, and each succeeding season, they will have from 2 to 3 litters per year. A study of muskrats in Iowa marshes showed that as many as ¼ of the females had 4 litters per year and that a few had 5. The number of litters per year depends to a large extent upon the length of the warm season—more litters south, fewer to the north. The young grow very quickly. At birth they are blind, hairless and completely helpless. In a month's time they are weaned, fully furred and look like overgrown mice. When about ⅓ grown, they strike out on their own, migrating up streams or colonizing new sections of the marsh. A family may overwinter in a lodge and disperse the following spring.

It has never been definitely established whether or not the muskrat is polygamous or promiscuous. Pairs have been observed working on the same lodge but whether they were actively cooperating or not is hard to say.

Muskrat populations have a tendency to vary, often rather widely from year to year. A bad winter, an unfortunate flood during the height of the breeding season, a bad drought or hemorrhagic plague, may reduce their numbers to a low ebb and extensive marshes may be deserted or nearly so. Such is the recuperative power of the animal, however, that a few favorable seasons permit complete recovery. Aside from the population "highs" and "lows" due to local conditions, muskrats show a rather weakly defined, but nonetheless real, tendency to conform to a ten-year cycle of abundance. Why this should be so, and why, for instance, muskrats are believed to have larger litters and greater rates of recovery from disease during a cyclic "high" than during a "low" is quite unknown.

Bumbling and ungainly on land, muskrats are a joy to watch in the water. They dive and swim for long distances beneath the surface, propelled by those big hindfeet. The rudder-like tail is used for turning and, at slow surface-cruising, appears to act as a half-hearted scull. No



matter how hard the winter, or how thick the ice on his pond, the muskrat remains active. It can cover long distances beneath the ice of the pond and an ordinary winter holds no terrors providing the food supply holds up.

The muskrat has its fair share of natural enemies here in Pennsylvania. Among the most important of these are the fox, the mink, stray dog, the great horned owl and a few other of the larger carnivorous birds and mammals. It is not uncommon to find several muskrat carcasses around or in red fox dens. Even humans find the flesh of the muskrat good and many tens of thousands are eaten annually as "marsh rabbits."

Subspecies in Pennsylvania: Two as follows:

Ondatra zibethicus zibethicus (Linnaeus).
Range: Throughout the state except the southeastern corner.

Ondatra zibethicus macrodon (Merriam).
Range: Southeastern corner of the state.

BOG LEMMING — *Synaptomys cooperi*

Other names: Lemming Mouse.

It's hard to visualize a lemming without a Norwegian fiord to jump into. And their spectacular migrations, periods when the whole countryside boils over with these big, bob-tailed mice, are part of everyone's "nature lore." Perhaps not as familiar is the presence of a small lemming in our own backyards. Lemming mice—although not of the same species as their arctic cousins, are more closely related to them than to any other living mammals.

Our lemming mouse is a quiet, unobtrusive little field mouse who never boils over at anything and has never found its way into anyone's folklore. It's an unusual little animal nonetheless—a temperate zone pioneer in a group of rodents that are usually considered arctic dwellers.

A lemming mouse looks much like the common meadow mouse, a shaggy, short-legged, blunt-headed, brown and gray little animal. But it has a *short* tail (about the length of the hindfoot)—and broad, grooved upper incisors. No other Pennsylvania rodent has these distinct grooves except the long-tailed jumping mice.

The only other mouse in the State with such a short tail (that of the meadow mouse is at least 1½ inches long) is the pine mouse with its sleek, mole-like fur and its *ungrooved* upper incisors.

Like the meadow mouse, this rarely collected little lemming mouse is a grasslands animal, but apparently is more adaptable and is found in many situations which the meadow mouse usually avoids. Despite this it is not commonly seen, even by professional mammalogists, pri-

marily because they occur in scattered colonies often of a very temporary nature.

Little study has been given to the life requirements of this animal. Its responses in the field to changing environmental conditions are completely unknown, but it does seem that it is easier to find where this mouse used to live, its little "ghost towns" of abandoned runways, soggy nests and yellowed grass cuttings, than to find the animal itself.

Common habitat is an abandoned upland field where the soil is exhausted and the ground is a dense mat of acid-loving weeds, moss, curly mats of poverty grass, waving loose strands of broom sedge and scraggly, invading locusts, haws, sassafrass and other "weed" trees. Piles of grass cuttings, each an inch or so in length, and small bright green droppings are signs that a mouse is about somewhere (although not necessarily a lemming mouse). But, if the spot is a lemming mouse colony, a carefully placed trap may hold one the following morning. Often circular patches of grass several feet in diameter will stand out, yellowed and dry, where the stems have been nibbled out from beneath.

A lemming mouse "town" has much the same appearance as a meadow mouse colony—ramifying runways, grassball nests, scattered droppings and cuttings. A practiced eye can often identify the lemming mouse runs by their more littered appearance in contrast to the cleaner grass paths of the meadow mouse and by their dry upland habitat.

They may also occur in moist grassy meadowlands that have not been too heavily grazed and trampled by livestock and in sphagnum bogs in areas where these are prevalent. Indeed one of the common names of this mouse is "bog lemming." Throughout most of southern Pennsylvania cold sphagnum bogs (not cattail swamps) are rare, and the lemming mouse is perforce a dweller in old fields.

Although there is no direct evidence on this score, it is the impression of many collectors, that the bog lemming occurs in what is essentially sub-marginal meadow mouse habitat. The inference is that the larger, more aggressive, meadow mouse will appropriate the best of the moist, lush meadow areas or grassy bogs for its own use wherever possible, forcing the lemming mouse into diverse types of habitat, which, superficially at least, appear to have little in common—dry upland fields and wet sphagnum bogs. The little lemming, however, with its heavier jaw musculature and broader incisors, may just be adapted for a different corner of the world-of-grass, preferring different plants than the meadow mouse. They are known to subsist on a variety of grasses and grass seeds, ferns, mosses, occasionally fungi, groundpine, and liverworts.

Their molar teeth, like those of the meadow mouse, never form closed roots. As a result the teeth never wear out, but grow out of the gums as fast as the mouse wears them down. This adaptation enables the

tiny grazer to subsist on a diet of coarse grasses that would soon wear out rooted teeth.

The teeth may be potentially immortal, but their owners are decidedly not. The lifespan of a lemming mouse, like all other mice, must be measured in months. The reproductive potential is less than that of the meadow mouse, although the duration of the breeding season, early

RIGHT-BOG LEMMING — PINE VOLE SIMILAR EXCEPT FOR COLOR.

spring to late fall, is just as long. Litters vary from 1 to 6, with an average of 3 young per birth. Females obviously produce more than one litter per season as nursing females with well-developed young *in utero* have been trapped. How many litters per year and other "vital statistics" are not known.

Lemming mice are preyed on by an army of meat-eaters, owls, snakes, weasels, foxes, mink, coon, even bears. The effect of this predation (the long term effect) is again unstudied and unknown. They form a part of the diet of most carnivores and in this respect are as indispensable to a balanced woodland "economy" as are the meadow mice, yet their numbers are certainly less.

Completely innocuous to man, their little colonies are scattered and rarely occur in any but long fallow fields or other agriculturally unproductive lands.

The lemming hordes of the far north are a far cry from the timid and elusive little Pennsylvania lemming.

Subspecies in Pennsylvania: *Synaptomys cooperi cooperi* Baird.

Range: Practically all of the state except extreme eastern part.

Synaptomys cooperi stonei Rhoads.

Range: May possibly be found in the Southeastern corner of the state.

BLACK RAT — *Rattus rattus*

Other names: Blue rat; ship rat; wharf rat; house rat.

Representing another of our introduced rodent pests, and "commensals," is the black rat, which accompanied the ships of the earliest explorers to the shores of this country. With them came disease, potential destruction and contamination of man's goods and foodstuffs, as well as the horror that mankind feels toward this loathsome parasite. This mammal is a most unwelcome companion, but the product of man's own filth, carelessness and corruption!

The black rat is somewhat smaller than the brown rat, although its average over-all length is about the same—16.5 inches. The difference lies in the fact that the black rat has a much longer tail, averaging 9 inches as against 7 to 8 inches for the brown. This means that its tail is longer than its head and body, and just that much more unattractive, with its scaly, naked appearance, and with a decided crook at the end. Its naked ears are larger than those of the Norway rat, and its nose is more pointed and lacks the "roman nose" feature so characteristic of its brown relative. Although one could hardly call the black rat a graceful mammal, it is certainly more agile and quick in its movements than the brown, and 25 ounces is probably its maximum weight. One thing that can be said in its favor is that it has a glossy, rather soft coat when in prime condition; the long, guard hairs are jet black, or bluish black, while the undercoat may be grayish, and the underparts are lighter gray or silvery. The Norway rat has a much coarser, unattractive pelage. During the Middle Ages, when the black rat dominated Europe, it was common practice to use their pelts for inexpensive fur coats or trim.

This rat is just as prolific as the Norway rat, and can produce 3 to 7 litters per year, with an average of 5 to 7 in each litter. As many as 11 or 12 have been recorded. The gestation period is 22 days, but may be prolonged a day or so if the mother is still nursing a litter when she becomes pregnant again. The young are naked, blind and completely helpless at birth but are capable of breeding when only 3 months of age. The nest in which the young are born and raised is a crude affair, ball-like in shape, and constructed of rags, torn paper, bits of grass or straw—almost anything the female can get her paws and teeth into to drag to her elected shelter. A favorite nesting site is within the wall of a building, but at times a nest may be built in an outside burrow.

The chief differences between the brown and black rats lie in their history, distribution and habits. In its way, the black rat is an explorer and pioneer. The brown rat had not yet left Asia when the black rat had dominated Europe and invaded England (in the early 13th century). It is presumed that this rat also had its origin in Asia, but its spread to Europe was probably the result of traffic to and from Egypt, where it had already become established centuries before. Galley slaves

feared and *fed* on rats, even as the sailors of the American and British Merchant Marine did during the early part of the 19th century. Wherever man ventured and carried a supply of food, the rat stowed away, and when the journey ended it emerged to establish itself and propagate its young. If man abandoned a ship or colony, the rat, too, gave up and moved on with its host. The black rat vastly prefers to share *both* food and shelter with man—it does not seem to relish the idea of establishing life in the open and on its own.

The name "ship rat" has been given to it because it is the rat most commonly associated with ships. Along with its slender build comes agility and a propensity for climbing. It has no fear whatsoever of high places. By choice, in Europe at least, it lives in the upper portions of buildings, and when forced to vacate or fend for itself, it commonly makes nests in trees. In America this trait is not so conspicuous, and it seems quite content to live in basements, floors or barns, and even in burrows. Mooring lines are excellent highways to ships, and the ship rat makes good use of them. Even when a ship is moored out in a roadstead, the ship rat does not hesitate to plunge off a wharf and swim to the anchored ship, climbing aboard with the greatest of ease. Once aboard, if food and shelter are readily available, it is content to remain.

The brown rat, on the other hand, usually boards ships involuntarily. In other words, it comes aboard in cargoes of grain, packing material, or something of that nature, but leaves the ship as soon as the voyage is ended—it does not sign on for another voyage if it can help it! The black rat, therefore, preceded its larger cousin throughout the world, and is constantly being reintroduced at port towns. It seems to prefer the warm climates, and has become well-established in the southern Gulf towns, and in Central and South America, while its numbers have ebbed and flowed in the northern part of America. Stringent laws for the fumigation of ships, in an effort to rid them of rats and the danger of reinfestation of port towns, has done much to curb rat immigration. With the full realization of the deadly potential of a high rat population, both in terms of disease and economic loss, drastic steps (poison campaigns, sanitation, etc.) are being taken, and they are having a gradual effect in many places, although the problem is still an enormous one. It is safe to assume that the black rat came early to Penn's Woods, for the Commonwealth of Pennsylvania was the second of the original thirteen states. From the early settlements of the eastern portion of the State, trade routes were rapidly established toward the west. With the traders, their families and the Conestoga wagons, our pioneer ancestors and their rats soon dominated the landscape, and the invasion of Pennsylvania by man and beast was accomplished. All went well for awhile. Cities sprang up, forests went down, the population increased by leaps and bounds, and the black rat thrived in its new environment. Then a curious thing happened. Along about 1775, came the Revolution, and with it the arrival of the Norway rat, via the troop and supply ships

of the English Navy. Into and through Pennsylvania marched the troops with their brown rats and gradually the black rat faded into oblivion before its larger cousin.

By 1900 the black or blue rat had become a rare animal in this State, although there were a few colonies of them in the northern counties. Carnegie Museum has eight specimens collected in McKean County, 1899, and one specimen from Westmoreland County, 1898. From that time until 1957 not another specimen was taken by collectors, although an extensive survey of the State was made from 1946 until 1950. It was presumed that all colonies had been exterminated. However, in March 1957, Mr. Charles Cross of Renovo, Pennsylvania (Clinton County), killed a black rat and reported that they still had a few of them in his region. Why a few black rats should persist in the State is a mystery, for the chance of reinfestation (such as occurs in port towns) is not very great. Perhaps the Norway rat did not find certain areas to its liking, and although its ranks were decimated, the black rat managed to hang on.

The black rat is not as aggressive as the Norway rat, nor does it appear to have such a vicious nature. It is extremely shy and wary, but when cornered, will not hesitate to take on all comers. One cannot underestimate its potential danger, however, for it carries all of the same diseases as the brown rat, and has been responsible for the great plagues of history.

It has been estimated that during the 1500 years before the Christian era there were 41 major epidemics; in the first 1500 years of the Christian era there were 109 epidemics, and from 1500 to 1720, 45 epidemics. The plague is 50 to 90 percent fatal to man.

It would be difficult to estimate the total amount of economic loss which has occurred as a result of the rat's depredations throughout the land. The rat, whether black or brown, should be rigidly controlled, or exterminated completely, if possible. The methods recommended for the control of the brown rat are applicable to the black.

Species in Pennsylvania: Rattus rattus Linnaeus.

Range: Rare in this State but may still be found in some isolated localities.

NORWAY RAT — *Rattus norvegicus*

Other names: Common rat; house rat; barn rat; alley rat; sewer rat; brown rat; domestic rat.

Like the house mouse, the Norway rat is a "commensal" and is dependent on man. However, there is a difference. The house mouse is small, timid and rather amiable in disposition; the Norway rat is just the opposite.

A full-grown, fully mature rat measures 15-18 inches in total length, with a tail of 7-8 inches and a hind foot of 1.6-1.7 inches. Although normal rats seldom exceed ¾ of a pound in weight, there have been exceptions which weighed in at 2 pounds.

From the standpoint of the average human being, rats epitomize evil, for they are vicious with or without provocation; they spread and transmit disease through their filthy habits; they are cunning and crafty and often outwit their human predators; and, most lamentable of all, they cost the citizens of the United States an estimated $200,000,000 yearly.

On the good side of the ledger, the only thing that can be said for them is that they provide the parent stock for exceptionally fine laboratory animals. As in the case with the house mouse, the white rat of the laboratory is simply a carefully bred result of wild albino stock. Albinos have notoriously bad eyesight (in bright light), and are inclined to be timid, possibly because they are so conspicuous. Taking advantage of this, man has been able to breed a race of white Norway rats that can be handled with impunity and have lost all the viciousness of the wild strain. Much of our medical research has leaned heavily on these rats for experimental work.

Even in physical appearance the brown rat is unattractive. Its rather coarse fur may be blackish, brownish or grayish above, becoming paler gray or yellowish below. The large ears are hairless and the tail is long, scaly, ringed and nearly naked. Its movements are characterized by a slinking, furtive gait, which at once suggests the evil nature of the beast. This rat is the villain of the mammal world, dedicated to a life of crime, unrelieved by any hint of playfulness or lightheartedness.

The Norway rat is not, of course, native to this continent, and did not reach the United States until approximately 1775. In spite of its common name "Norway," it is not native to that country either. Its history and distribution, therefore, is rather interesting. The black rat was the common rat in Europe up until the beginning of the 18th century, and the Norway rat was unknown; but a startling occurrence took place about 1727. For some reason, perhaps the pressure of over-population, lack of food, or an urge to see the world, a vast horde of brown rats left their native Asia and started on the march. Hundreds of thousands moved by a northwesterly, overland route, through Russia and then into Europe, respecting neither rich nor poor, invading the homes of nobles and peasants alike. History has never seen such a mass migration, and the startled, worried folk of 1727 (and succeeding years) hastened to record the awful invasion. By 1750 the brown rat had reached Paris, and found a veritable Paradise in the sewers and filth of that splendid city. By 1728 or 1729 England had been invaded by rats which had managed to hitch rides on ships and colonies were established there. The Scandinavian countries got their share and Europe was conquered completely and thoroughly. Then the overseas invasion began. In car-

goes of grain and other foodstuffs, the brown rat smuggled itself aboard the ships sailing for the New World, and about 1775 the colonies took note of a new arrival. From the Atlantic seaboard the unwelcome companion of man spread westward, and by 1923, Montana, the last State in the Union to be free of this pest, finally succumbed. In the meantime, *via* the ships of our nation as well as those of the Old World, the brown rat continued its march westward and finally completely circumnavigated the globe. So, in less than 200 years the brown rat made the world his home, and has forced mankind to pay homage to him ever since.

Wherever their paths have crossed, the slightly smaller, but equally dangerous black rat has either completely, or almost completely, disappeared as the brown rat established itself. There appears to be no tolerance between the species and the weaker race succumbs to the stronger. With an adequate food supply and plenty of shelter, it seems strange that the two races cannot co-exist, but in both the Old and the New World, the pioneer black rat has faded before the late-comer, the brown rat.

Many things account for the successful international conquest by this rodent. In the first place, it is a highly efficient reproductive animal. Secondly, few barriers can be placed in its path, for it can dig under, climb over, go around or swim through most natural obstacles. Thirdly, its shelter requirements are extremely simple. And last, but not least, man is a handsome provider when it comes to food.

Pennsylvania has a thriving, vigorous population of Norway rats. Every hamlet, village and town has its share, and many farms have more than their share. Truly feral colonies are relatively rare but do occur.

The brown rat seems to prefer to remain on or below ground, but it can and does climb readily and well, although not with the agility of the black rat. It also swims exceedingly well, and does not hesitate to take up residence in marshy places or along river banks. It will establish itself near a fish hatchery and with the greatest of ease proceed to use the fish fry as a source of food. Its appetite is prodigious and all-encompassing, and it does not hesitate to indulge in cannibalism if the

occasion demands. When a blood-lust descends upon it, it may enter a poultry house and kill chicks and grown hens, never stopping until all the inmates are dead or the rat itself is destroyed. On these relatively rare occasions, the rat does not seem to be motivated by a desire for food, but rather by the desire to kill.

Although the house rat is a shy animal, and usually prefers to carry on its activities by night, it is by no means timid. A cornered or trapped rat will take on all comers with a courage that has made man coin the phrase: "to fight like a cornered rat." Although the implication, when applied to mankind, is not very flattering for it infers a fight with no holds barred, it does pay tribute to the valor of a small animal which will unhesitatingly tackle the largest man or beast.

The Norway rat is remarkably productive. When only three to four months of age it will breed, and it may have litters numbering from 6 to 22 young, although the average litter contains 5 to 7 young. The gestation period is only 21-23 days, and the female may be pregnant again before she weans her young. The young are blind, naked and helpless, but they grow rapidly and are weaned at 3 weeks of age. A female may have anywhere from 3 to 6 litters a year, and her breeding life may continue until she reaches the age of 1½ years. In the meantime, her young are reproducing, and so are the young's young, and so *ad infinitum*. The potential is indeed alarming! In captivity a rat may live about 3 years, but evidence indicates that 2 years is the maximum life for a wild Norway rat.

A home site is not difficult for a rat to find, and almost any dark and secluded corner or hole will do. Rats can dig burrows when they are not utilizing the interior of a building for shelter. These burrows are rather shallow affairs, usually only about a yard in length and about one foot below the surface of the ground. In this burrow will be a nest cavity and one or more enlarged places for the storage of food. The nest cavity will contain a big, rough nest ball composed of grasses, paper, rags or other materials.

Often the burrow will have more than one entranceway, and sometimes the rat will plug the entranceways when young are in the nest. On occasions, when a large population of rats exists, there will be complicated burrow systems, as a result of many rats working in close proximity.

The voice of the rat is not particularly pleasant to hear. A squeal of rage or alarm is the sound most commonly heard by humans, although at times a rat may gnash or chatter its teeth, or utter a hiss when it is cornered. A large number of rats may be heard to squeak and chitter, and they undoubtedly make a variety of other noises.

Individual house rats do not wander very far in the course of their activities, and it has been estimated that 100-150 feet is an average

"home range." In this limited area a rat may live and die, and will fight fiercely to protect its own property. A rat brought in and released will be promptly driven out or killed by the resident animal.

In addition to man, the brown rat has many enemies. Hawks, owls, weasels, mink, foxes, large snakes, cats and dogs are among the most notable. Young rats, however, are the customary victims, for old, large and wary adults are more than a match for some of the above enemies. When one considers that the brown rat will unhesitatingly enter the cages of large mammals in a zoo and try to eat the unfortunate victim while it is still alive (elephants have had their toes chewed off for example), it is no wonder that even their most avid enemies approach them with caution. The Norway rat has been known to bite babies in their cribs and even attack adults while they were asleep.

The economic importance of the rat's depredations cannot be over-estimated. Livestock foods are eaten and contaminated, as are stored fruits and vegetables, and crops in gardens and fields; poultry and eggs are destroyed, together with baby pigs and lambs; and much property is damaged through burrowing and gnawing. It is frightfully expensive in many cases to take the necessary steps to control them. To do a successful job three things must be done completely and thoroughly: (1) shelter for them must be removed; (2) all food supplies placed in rat-proof containers; and (3) the rats themselves must be destroyed. If only the latter step is taken there will be prompt reinfestation. Traps, poison, guns and fumigation are the most common methods of control.

The really great danger from the Norway rat, however, lies in its ability to transmit disease to man and his livestock. It has been said that this relatively small mammal has caused more deaths than all the wars of history. The lice and fleas which it harbors transmit plague, typhus, trichina, infectious jaundice and many other diseases. Rat-bite fever (sodoku) is the result of an organism transmitted by the rat when it bites human beings and is exceedingly dangerous. The danger of the rat simply cannot be over-estimated, and it is imperative to the health and welfare of a community to see that all necessary steps are taken to control this pest, effectively and efficiently.

Subspecies in Pennsylvania: Rattus norvegicus norvegicus (Berkenhout).

Range: Throughout the state.

HOUSE MOUSE — *Mus musculus*

Other names: Domestic mouse; common mouse.

Certain it is that the ubiquitous little house mouse needs no introduction to the citizens of Pennsylvania. It has been pursued, feared and the butt of innumerable cartoons for lo, these many years. The car-

toonist delights in portraying a member of the "weaker sex" standing upon a chair, screaming with terror at a tiny mouse sitting calmly on the floor; or in depicting an elephant, trumpeting with panic as the little marauder scampers about his feet. But what is *really* known about our most common household pest? Where does it come from? And why do we have to put up with it?

To begin with, the house mouse is not native to the American Continent. It was not here before the white man arrived and only began to put in an appearance about the time of the American Revolution. It is what is technically known as a "commensal"—a mammal especially adapted for life with man and, in a sense, fitted to live and eat with him. The alley rat falls into the same category and, in the bird world, pigeons and English sparrows occupy the same niche. Under ideal conditions the house mouse may become "feral," *i.e.* revert to life in the wild, just as the domestic cat or dog may, if shelter, food and security are no longer offered to it. But it would seem that the little European immigrant vastly prefers the bountiful table and delightful security of man and his sturdy dwellings.

The house mouse is really not a repulsive looking animal if one examines it closely. It is about 6 or 7 inches long over-all, with the tail as long, if not longer, than the head and body. It is about an inch high at the shoulder, has large, expressive ears and small, beady eyes. Unfortunately the tail is scaly and almost naked, which spoils its appearance somewhat. The coat is variable in color, ranging from light brown to black on the upper part, with the underparts somewhat lighter, often with a buffy wash. But the general impression that one gets is that it is a little gray mouse. The fur lies snugly against the body and may be quite glossy, giving the animal a rather dapper appearance. At best it weighs no more than an ounce and the average weight is $\frac{3}{5}$ of an ounce.

Our Pennsylvania house mouse came from northern Europe, primarily via the ships of England, France and Germany, and this particular race now ranges throughout the northern portion of the United States and Canada. A short-nosed race occurs throughout the southern part of the United States, and where the ranges overlap the two interbreed freely.

The scientific name, *Mus,* is the Latin word for mouse, which is a rather cut and dried definition. It has been suggested, however, that the word "Mus" is actually derived from the ancient Sanskrit word, "Musha" meaning "thief." If the latter is the case, then the animal is truly well-named, for it steals from the human race shamelessly and continuously.

The house mouse can wiggle through incredibly small openings, and in spite of all that a meticulous housekeeper can do, the tell-tale marks of the intruder may appear in the newest and most immaculate of dwellings. Little black, hard pellets are usually the first indication of an

invasion; then, perhaps, a bit of shredded paper, string or cloth may be observed tucked behind a sofa or in a remote corner. This is not the result of slovenly housekeeping, but rather that the house mouse goes where man goes, in spite of man's best efforts to thwart it. There are so many ways for the house mouse to enter dwellings that it is necessary to wage almost incessant warfare to keep them out.

One of the main reasons that the house mouse has been able to survive, in spite of innumerable enemies and the best efforts of man, is its astounding ability to reproduce its kind. The rabbit is prolific, to put it mildly, but it hardly holds a candle to the common mouse. From early

spring until late fall, the female is busy raising litters. The gestation period is 19 to 21 days, and 12 young may be produced at a time, although the average number is 5 to 7. The young are born naked, pink, blind and helpless, but in 3 weeks they are weaned. Within 35 days or less, they too may begin to reproduce. The possibilities are staggering, if one contemplates for a moment the potential mouse population, if all the mice produced survived even 18 months.

It is easy for a female mouse to find a suitable home-site for a nest. Almost any old thing will do, and almost any type of material can be shredded to form a cozy little ball. Corners of shelves, dresser drawers, receptacles such as pots, cans and bowls, a seldom-used sofa or easy chair or the insulation inside a wall may be utilized. Newspapers can be shredded neatly by the prospective mother, and it is positively amazing what a mouse can do with a ball of string or a convenient rag or curtain! When the nest ball is completed it is difficult to find the entranceway, and, once inside, the mouse and her young may completely escape detection.

Each individual house mouse spends its entire life within a relatively limited area, probably covering little more than 250 yards, except under

stress of unusual circumstances. Trapping experiments have been carried out in large cities, using a city block as one unit. In Kansas it was learned that an individual mouse might move from one building to the building next door, but a 16 foot alley seemed to provide a definite barrier. In Baltimore it was ascertained that a main street was a definite barrier, and the mice on one side were intolerant of the population on the other side of the street. In other words, if live mice were carried across the street and released, the resident mice soon drove them out or killed them. Water may also be a barrier, for although this mouse swims with ease, it does not like to get wet.

The house mouse is omnivorous—that is, it will eat almost anything man has to offer or can raise! Basically it prefers grain and various vegetable products, but through long association with man it has learned to eat practically everything. Strangely enough, one of the things that it really seems to relish, much as a child likes a lollipop, is the glue from the bindings of books or magazines. Traditionally the mouse is associated with cheese, but the attraction is not as great as generally believed. For baiting traps, a mixture of bacon and peanut butter produces better results than cheese, and a piece of meat tied to the treadle will often do the trick when the use of cheese fails.

This mouse produces a variety of sounds, and the one known best perhaps is the loud, shrill squeak which it makes when trapped or nabbed by a cat or dog. However, when not terrified or alarmed, it often makes a series of rapid squeaks or calls which are undoubtedly understood by other mice. Then there are the individuals who sing! Their song is tiny, shrill and thin, similar to that of a canary, but not as melodious, although rare individuals who have taken up their abode in television sets or radios may trill almost in time to the music. Many theories have been advanced as to why the house mouse sings, and why sporadic outbreaks of singing mice occur, but the real answer is as yet unknown. However, there does seem to be a definite correlation between high populations of mice and this phenomenon.

The house mouse is a nervous little beast, but it is not a vicious animal like the alley rat. True, it will bite when cornered, or when defending its young, but on the whole, it has a pleasant disposition. It is too nervous, however, to make a good pet. White mice, which have been bred for generations for laboratory use, are really only albino house mice. Constant selective breeding and handling has eliminated much of the nervousness from laboratory stock, and they make almost ideal pets, for they rarely, if ever, bite. In captivity, and with adequate care and a good diet, a house mouse may live from 3½ to 6 years.

Although it is true that the house mouse is normally dependent on, and follows man in all his travels, they are capable of reverting to the "wild" when circumstances are favorable. Colonies of these mice have been found several miles from the nearest inhabited dwellings and ap-

peared to be thriving on the available seeds and grains. They are frequently found in large numbers in shocks of hay and in corncribs, but these animals may return to barns or farmhouses when winter sets in. Truly wild and independent colonies arise when a farm is abandoned, or a village deserted, or an exposed garbage dump exists for a lengthy period of time. In Europe, such colonies sometimes "erupt," and a vast horde of mice travel over the countryside destroying everything edible in their path. Very few such eruptions have occurred in the United States.

House mice are easily taken in ordinary snap traps. Traps should be set at right angles to the wall and baited with a dab of bacon or bit of peanut butter. The treadle of the trap should be next to the wall. The old story that a trap must be sterilized before it is re-used is false; it can be reset immediately after a mouse has been caught. Intensive trapping will usually provide prompt and efficient results.

Subspecies in Pennsylvania: *Mus musculus* Linnaeus.

Range: Throughout the state.

MEADOW JUMPING MOUSE — *Zapus hudsonius*

Other name: Kangaroo mouse.

Haying time is not what it used to be, but one of the diversions of this farm chore, at least for the boys, is the chase after the "kangaroo mice" that sometimes erupt from under the fork and bounce off across the field with all of the drive and unpredictability of a pogo stick.

A striking little mammal, with its tremendous hind legs and ridiculously long tail, the jumping mouse looks as much like a miniature kangaroo as it does a mouse. Both the jumping mouse and the kangaroo are adapted for hopping, but that's as far as the relationship goes.

The meadow jumping mouse is built for the job—small forelegs, enormous hind feet and a long tapered tail, one and one-half times as long as its owner. Most small mammals are rather somber shades of gray or brown, but the jumpers are brightly colored. Its underparts are snow white, the sides vary from dull to bright yellow and are heavily peppered with stiffer black guard-hairs. A broad dorsal band of olive-drab runs from head to tail. The ears are conspicuous but small, covered with short brown hairs and narrowly edged in yellow. Feet are white on top, their soles bare. The tail is scaly, scantily furred, and utilitarian. The eyes are well-developed but not bulging out of their heads, like those of the strictly nocturnal white-footed mouse. A full grown *Zapus* will measure 8 to 9 inches in length; 5 to 6 inches of this will be tail. It will tip the scales at about ½ ounce in the springtime; perhaps a full ounce in the fall.

This is a meadow-loving mouse, rarely making the subterranean tunnel systems so characteristic of other mice. It prefers not to put its faith in secretiveness but in its long hind legs. The usual gait of the jumping mouse is a normal four-legged scamper, but when frightened or in a hurry the hind legs take over and the creature takes off in a high-arcing leap that may propel it 6 to 8 feet at amazing speed. A series of these impressive leaps is enough to confuse any pursuer and add delight to the hayfield scrambles.

But these wild leaps have one great disadvantage—the mouse cannot always forecast where it will land. In fact, this seems to be an exceedingly bumbling little animal. If there is anything about that he can fall into, he will sooner or later. A line of newly-dug postholes, stretching off through some field and half-filled with water from a recent shower will almost invariably catch a jumping mouse or two, if there are any around to be caught.

The typical habitat of the meadow jumping mouse is a wet grasslands, where vegetation is luxuriant and provides both food and cover. *Zapus* ranges widely, however, and may be expected in almost any meadow or old field. These little animals are good swimmers, and will take to water without the slightest hesitation. But the water is a dangerous spot for a small mouse. Trout, bass, snakes, turtles, even bullfrogs, all welcome him as food.

These mice, like the woodland deer mice, are primarily seed eaters. Seeds, berries, tender plant stems, occasionally insects, make up their fare. Often specimens are trapped with their fur stained a blackberry, raspberry or strawberry color, leaving little doubt as to what the animal

has been eating. They have been seen climbing dock *(Rumex)* to get the ripening seed heads.

Young are born in shallow subterranean nests, usually grass-lined. There is a good deal of circumstantial evidence, based upon the occurrence of embryos in trapped females, that there are at least 2 litters of young per year, one in the spring and one in late summer, probably August. Litters average large, usually from 5 to 8.

This toothsome morsel is on the diet of every predator in the State and it is literally just "one jump" ahead of death most of the time. Even the sluggish, but deadly rattlesnake, captures a good many. Snakes, weasels, foxes, cats, mink, hawks by day and owls by night, all make short work of wayward jumping mice. One saving thing is the fact that for 6 months of the year the jumping mouse is in cold storage and unavailable to predators.

This mouse, and the closely related woodland jumping mouse, are our only hibernating mice. The provident deer mouse and the squirrels and chipmunks build up stores of seed to munch on during the cold months of a northern winter, but the jumping mouse stores its resources about its middle. By October it is round and sleek, wrapped in a blanket of subcutaneous fat with which it will sustain itself during the long sleep ahead. Hibernation usually begins in October, although a few hardy individuals will be found hopping about in the first snows of November. The mouse picks a well-drained spot, possibly in the side of a dirt pile, on a hillside, or even a tunnel or an old woodchuck burrow. Any spot well protected from water and below the frost line will do. Here it constructs a small, grass-lined nest, curls up into a tight little ball, nose on chest, tail tightly coiled, and hibernates. The body temperature drops, circulation slows and respiration which in a fully active mouse may be 145 per minute, now becomes imperceptible.

These mice remain in this state of suspended animation in Pennsylvania from October until about the last of April. Hibernating jumping mice are very difficult to arouse when brought into warmer surroundings and soon lapse back into unconsciousness when exposed to the cold again. Hibernation is an adaptation that enables these mice to survive where they otherwise would not. Jumping mice, with their long tails, large hind legs, coarse fur and open, active habits, are not well adapted to conserve body heat. Some of our small mammals have responded to the challenge of winter by storing seeds, others by living underground, but jumping mice apparently just go to bed and forget the whole thing! Occasionally they have been found hibernating in pairs.

This species is found throughout the State, wherever suitable habitat occurs. The similar woodland jumping mouse, a slightly larger, brighter animal with a white-tipped tail, occurs in woodlands. Sometimes the two species will be found together, but neither ventures very far into the other's domain.

The numbers of these mice vary from year to year. A season where they seem to bounce in every meadow will be followed by seasons where they are most uncommon.

Subspecies in Pennsylvania: Zapus hudsonius americanus (Barton).

Range: Throughout the State.

WOODLAND JUMPING MOUSE — *Napaeozapus insignis*

Other name: Kangaroo mouse.

Take a rod and a reel, a few dry flies, and cast your way up to the mountain headwaters where the native trout lie. Here is where, if you are ever to be so privileged, you may form an acquaintance with the woodland jumping mouse. Not a mouse to stoop to raiding pantries, nor to scurry about in dusty meadows or old corncribs, *Napaeozapus* is as wild, as elusive, and as beautiful as the brook trout of its native hills.

This one is the most handsome of the eastern forest mice, built more along the lines of a satyr than a mouse. The long, kangaroo-like hind-legs and the enormously long, thin tail 1½ times the length of the body identify it as a jumping mouse. And the white-tipped tail separates this species from the very similar meadow jumping mouse. Just why one kind of jumping mouse should sport a tail with a tip that looks as if it had been dipped in white paint, while the other must do with a plain old tail, although equally as long and slim, is a mystery.

The woodland jumper is colored much like the meadow jumping mouse, only in brighter hues. The underparts are just as snow-white in both, but the yellow flanks and sides of the meadow jumper are now bright orange suffused with brown and black, and the white-tipped tail is of course a dead give away.

The meadow jumping mouse is a slightly smaller animal (8.7 inches long with a 5.3 inch tail as compared to 9.5 inches with a 5.8 inch tail). *Napaeozapus* also lacks the tiny peg-like tooth that lies in front of the upper molars of the meadow jumper. Both species have a deep groove running down the center of each of the large, orange colored upper incisors. This alone will distinguish them from any other Pennsylvania mammal. The bog lemming has grooved incisors, too, but in this case the groove is very shallow.

The *napaeae* were (or maybe still are?) woodland fairies or nymphs, and while *Napaeozapus* doesn't hop about the woodlands scattering rose-petals as it goes, the simile isn't a bad one. When alarmed it takes off in a series of reckless, frog-like leaps that seem to make it vanish instantaneously. One minute it's here, the next, 10 feet away. In dense

WOODLAND JUMPING MOUSE — MEADOW JUMPING MOUSE IS SIMILAR.

underbrush it literally vanishes. During these convulsive bounds the forefeet never touch the ground, but at more normal speeds, the mouse does have a conventional four-footed scamper. The excessively long tail is necessary for counterbalance during these long leaps, and may be utilized as the third leg of a three-legged "stool" when the forelegs are busy fumbling with dinner.

The woodland jumping mouse occurs throughout the State, but its distribution is entirely dependent upon the availability of proper habitat. It is most common in the mountain areas and in the northern counties, but, even there is local in distribution. Look for the woodland jumper along the shaded banks of a trout stream, in cool mountain bogs, in dense upland forest with their moss-covered tangles of fallen logs. Two factors seem essential in the habitat preferences of this mouse—water and deep woodland. Occasionally, possibly in times of higher populations, they venture out into fields or grasslands, but as a rule, seem content to leave the wide, open spaces to their cow-pasture cousin—the meadow jumping mouse.

All rodents can gnaw, but some are much better at it than others. A squirrel is a four-legged nutcracker capable of handling the toughest walnut, while way down at the bottom of the list are the jumping mice. These delicate little mice would find it tough going on a squirrel's fare. They are adapted for much smaller seeds, those of grasses, woodland fruits, raspberries, blackberries, blueberries, plus an endless variety of smaller herbs. They have been seen feeding on ripening May-apples *(Podophyllum),* on alder fruits, and on seeds of the false mitre-wort *(Tiarella).* They can climb with ease to harvest a high-hanging berry. Captive *Napaeozapus* will eat strawberries until they are quite literally red in the face. Jumping mice also consume a fair number of insects. Apparently a certain amount of animal protein is essential to the animal's well-being.

Hibernation in jumping mice is a profound business, and they are our soundest winter sleepers. From late October until late in April *Napaeozapus* hibernates in a leaf-lined retreat underground, inactive as a mid-winter golf ball. The actual dates of hibernation vary from year to year, and they have been taken as early in the spring as April 27. Early fall or late spring cold snaps have little effect upon the activities of these mice and they often hop about their business with snow upon the ground.

The exact dates of hibernation are not set by day to day weather conditions, but are related rather to the physiological "readiness" of the animals. Jumping mice, like bears, store up an enormous amount of fat each fall (about 30% of their total body weight). Most of the jumpers settle down in late October, but a few "thin" ones, possibly young of the year, may continue activities for a few weeks longer despite the lowering temperatures.

During the first few days after the onset of hibernation these fat little mice lose weight at what seems an alarming rate, but as hibernation becomes deeper and deeper weight loss gradually lessens. The weight loss of captive mice hibernating in outdoor cages was found to be about 30 per cent of the initial weight from October to late April.

Breeding commences soon after the mice emerge from hibernation in the spring. The gestation period is a little over 3 weeks (23 to 25 days). Young, from 3 to 6 or more, are born in the seclusion of a leaf-lined nest under a log, in the soil or in the center of a hummock of grass. They grow rapidly. At 2 weeks, eyes are open and the pink bodies are fully furred. At 3 weeks from birth they are on their own. Pregnant females have been taken in the State from May through August, indicating that they have more than one litter per season.

There is some circumstantial evidence that jumping mice travel in pairs for at least a part of the year. Mousetraps set in pairs have rather consistently caught two jumpers of the opposite sex.

As conspicuous as they are, and as toothsome to predators, these mice must have a very high mortality rate. The average life span is less than a year. Their only assets for survival in the life and limb department are those powerful hind legs and the six-months respite of hibernation.

Subspecies in Pennsylvania: Napaeozapus insignis insignis (Miller).

Range: Throughout the State except southcentral and southeastern section.

PORCUPINE ***Erethizon dorsatum***

Other names: Hedgehog; quill-pig; Canada porcupine; porky.

Although the porcupine does not occur everywhere in the State, it is certainly one of the best known of our mammals, and easily the most quickly identified. Its scientific name, *Erethizon,* is derived from the Greek verb, meaning to excite or to irritate, in allusion to the spines, and it is a most appropriate name. Quills are to the porcupine as odor is to a skunk—one and inseparable in the human mind!

In general appearance the porcupine is definitely distinctive and not particularly beautiful. It is a large, slow-moving, awkward looking rodent, with bright orange incisors which it uses most effectively on the bark of trees. An adult specimen averages 36-40 inches in total length, with a tail of 6 inches. A large adult may weigh 20 pounds or more.

The color varies from slaty black or brownish black to black, sprinkled on the upperparts and sides with light tipped hairs which are whitish to yellowish white. The spines, or quills, are white, tipped with black,

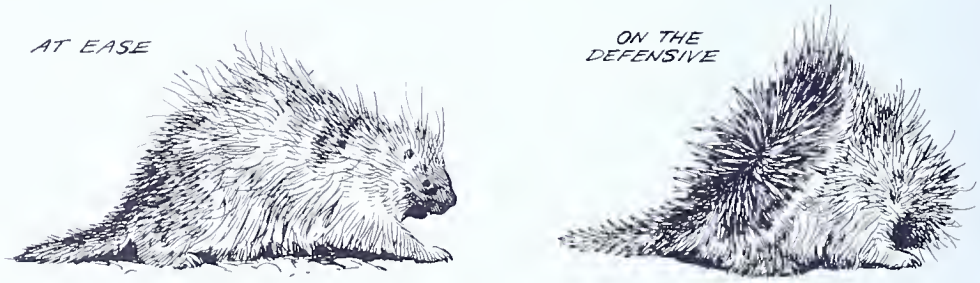
and are barbed. The barbs slant backwards and when imbedded tend to work inward. Infection often results if they are not removed promptly, and wild mammals frequently die because they cannot extract the quills from their mouths or bodies.

The porcupine's face is snout-like in appearance and the black eyes seem to lack sparkle and enthusiasm. It is not an animal to capture the imagination of those who appreciate natural beauty.

In Pennsylvania the porcupine is confined to the most extensively forested portions of the State, particularly about rock outcrops or massive blocks of residual sandstone, where suitable den sites are available. It is not necessarily confined to high altitudes, and may occur in heavily forested mountain valleys, as well as on mountain tops.

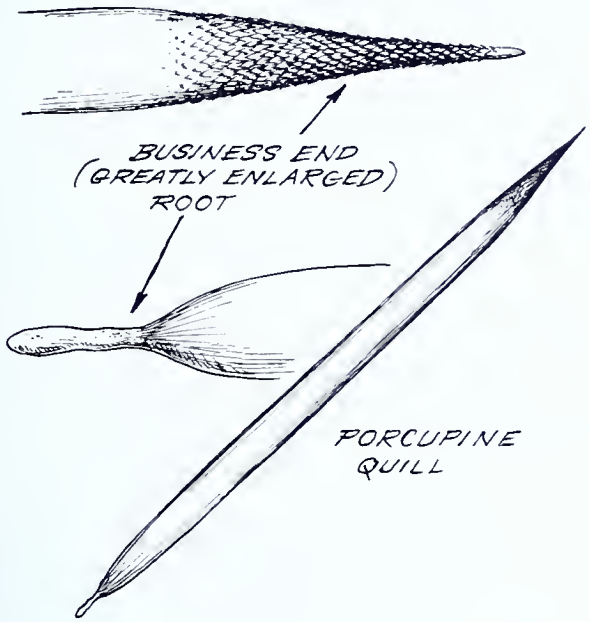
During the summer months, the porcupine eats a wide variety of plants, but in the winter it lives almost entirely on the inner bark of trees—white pine, pitch pine, hemlock, black cherry, maple and aspen, as well as birch, oak and beech. While climbing a tree it frequently clears its way by biting off branches and, as a result, the presence of the animal can often be detected by the pile of little branches on the ground around a tree.

The individual animal does not appear to have a very extensive range, and cases have been recorded in which a single porcupine spent several months in one or two trees, systematically exhausting its food supply. When this happens, the tree may be destroyed by girdling, but the evidence seems to be quite clear that the destructive force of the porcupine is not as great as commonly thought. The porky is also very fond of apples, but its one over-whelming passion is for salt. For salt it will do almost anything, and this trait has made it the enemy of those who have cabins in the land of the porcupine. Nothing is sacred—camping equipment of all kinds which bears the slightest trace of sweat is eagerly gnawed to destruction, even the floors and doors of the cabin itself. Cupboards are gnawed through and the contents ruined as this



rodent systematically seeks its favorite flavor. It is quite likely that this craving for salt is normally satisfied by gnawing on the shed antlers of deer, elk or moose which may occur in their range, but where man has invaded their haunts the porcupine finds a real Utopia in the hunting camps.

Because of the potency of their armor—the quills—much conjecture has taken place in regard to the breeding habits of the porcupine. The defense mechanism of this rodent is simple. When threatened, it turns its back to its enemy, lowers its head and tries to protect it under a rock, bush or log, then rapidly swings its bushy, quilly tail from side to side. At the same time, all of the quills along the back are raised, for the animal has excellent control of the muscles which erect the spines.



A porcupine *cannot* throw its quills, but often quills fall out when the tail is swished violently, for they are very loosely attached. If the enemy attempts to seize the porky, it is apt to find itself with a face and mouth full of quills. It is natural, then, to wonder how breeding can take place without injury to either the male or female. All sorts of solutions have been suggested—many of them fanciful.

For many years Dr. A. R. Shadle kept and observed a colony of porcupines, watching their breeding habits and carefully noting, by pen and film, just what took place. It was found that the male, on his hind legs, approached the receptive female from her rear, the female remaining on all fours. She then raised her tail or moved it to one side, at the same time keeping all quills tightly appressed to the body. The male then made contact, hunched over but not grasping the female, also with his quills appressed, and the act of copulation was easily performed. If an individual is quilled, either during the breeding act or during a fight, that individual will extract the quills carefully and cleverly.

It is interesting to note that among a group of mammals which are usually so prolific—the rodents—the porcupine customarily gives birth to only one young per year. Breeding takes place in the fall, and after

a gestation period of seven months, the single young is born. Usually it is still in the embryonic sac when delivered, but as the female moves about during and after the birth, the sac is torn immediately and the young can breathe. At birth the young weigh 12 to 20 ounces, the hair is long, thick and black or gray. The quills are one-quarter to one inch long, and although soft at first, they stiffen rapidly and are quite formidable after a few hours. The eyes are open at birth, and within a few hours the young ones can wobble around on all fours. Although nursing continues for many weeks, a baby porcupine is amazingly well-developed from the first, and proportionately, is a giant compared to a new-born bear.

Basically the porcupine is a solitary mammal except during the rutting season. This does not mean that one cannot find a number of porcupines within a restricted area. It simply means that they ignore each other—without fussing or fighting or showing any evidence of pleasure.

The porcupine has an unusual range of vocal accomplishments. A variety of grunts, coughs, moans, whines, sniffs, squeaks, mews, chatters, snorts and barks comprise a part of the vocabulary. When frightened or hurt, it is said to cry like a child, and at other times, for no apparent reason it will shriek with amazing loudness and clarity. This cry has been mistaken for that of a mountain lion, even by experienced woodsmen. Adults indulge in what Dr. Shadle terms an "exercise dance," which involves stamping about on their hind legs, or on all fours, but moving with a definite rhythm. In the breeding season there is a display dance, performed on the hind legs, accompanied by a thumping of the tail on the ground.

The porcupine is slow to mature, and probably has a life span of 10 to 12 years in the wild. Its chief natural enemy (aside from man) is the fisher, which alone among wild mammals appears to have solved the problem of killing this rodent without filling itself full of quills. Sometimes the great horned owl will attack a porcupine and may die from the many quills which pierce its breast and abdomen.

The real foe of the porcupine lies in and about its own person. It is more often than not, thoroughly and completely parasitized, and mange is commonplace. Very subject to tapeworm, and beset by countless numbers of internal and external parasites, it is no wonder that this unfortunate mammal plods along through life, head down and quills ever on the ready!

Subspecies in Pennsylvania: Erethizon dorsatum dorsatum (Linnaeus).

Range: Throughout the State.

Other names: Reynard; silver fox; cross fox; black fox; Samson fox; burnt fox; bastard fox.

Gay, handsome and debonair, the red fox is the Beau Brummel of the wild. He is impeccably dressed in an orange-red coat, with black leggings fore and aft, a touch of white at the throat and on the cheeks, and a magnificent plume, tipped in white, gaily waving behind. The erect ears, snapping black eyes under a wide forehead, and the sharp, pointed muzzle give him an alert, intelligent look, that is not belied by his personality! "Dumb like a fox," "stupid as a fox," "cunning as a fox" are just a few of the phrases which humans have coined to express their admiration and respect for the Scarlet Pimpernel of mammals.

Strange, isn't it, that man should compare himself to a rather small, dog-like animal and credit to it an intelligence equal or superior to his own! What manner of creature is this intellectual giant? Let the facts *and fancies* speak for themselves!

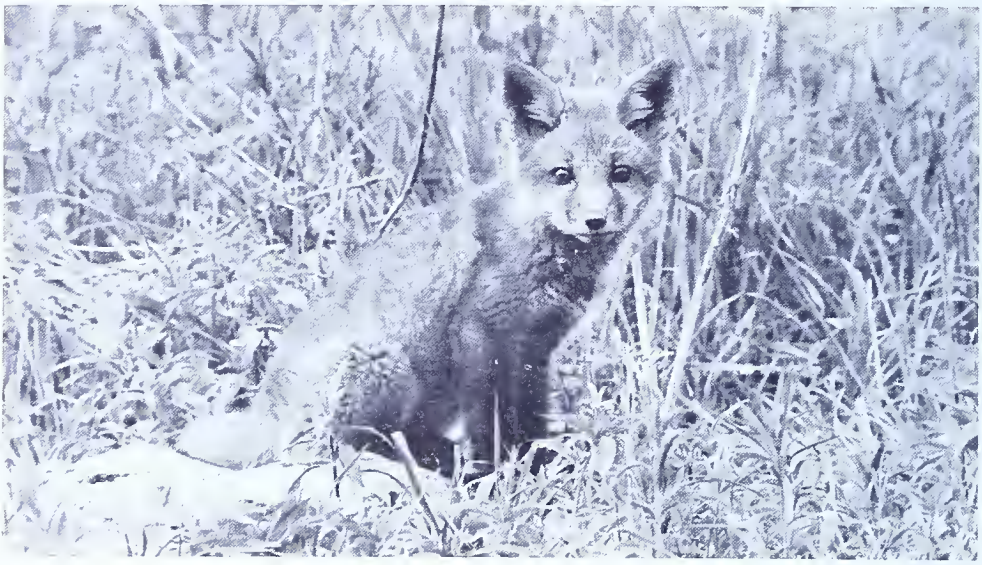
The generic name of the red fox is *Vulpes,* which is the Latin word for "fox." Its specific name, *fulva,* Latin for "yellow," indicates that the early naturalists in the New World considered this fox yellower

THE RED FOX is the Beou Brummel of the wild. He is impeccobly dressed in an orange-red coat, with black leggings fore and aft, a tauch of white ot the thraat and an the cheeks, and o magnificent plume, tipped in white, gaily waving behind.

than its Old World cousin. Its size is not really impressive, for it is about the same size as a small beagle and weighs from 8 to 10 pounds when fully mature. One giant of the species weighed in at 16¾ pounds, but that was definitely an out-size fox. Its coat is magnificent—long, soft, sleek and shiny. And the tail is something to behold—a glorious

brush or plume, fully 12½ inches long, not counting the tip hairs. The total length of the animal is approximately 40 inches, but the long, bushy tail, always tipped with a white powder puff, seems to equal the length of its owner. Like a fine collie ready for show, the red fox conceals its slim, lithesome, graceful body under a full fur coat. The red fox is a flexible steel spring, wrapped in red-gold fur.

At the present time the red fox ranges throughout Pennsylvania. There has been much speculation, however, as to its primeval range. The key to the past distribution of many mammals lies in archaeological sites



THE RED FOX female produces four to seven young which remain in the den for nearly a month. They are weaned at the end of two or three months, but remain with the parents until the fall.

—Indian refuse heaps at ancient villages and caves or sinkholes. None in Pennsylvania have yielded red fox remains—nor have any south of New England or east of Illinois. So speculation begins. There are some who contend that the red fox was imported from Europe to supply the gentry of the South with hunting pleasure. And so it was, but it hardly seems likely that these imports thrived well enough to populate the entire eastern seaboard. Sailing vessels took a long time to get from Europe to the New World and it is doubtful that many foxes survived the arduous voyage with the inadequate care that they would receive.

Then what alternative can be suggested? The red fox is incompatible with dense, unbroken forest, or complete civilization. When the settlers reached the New World the red fox did not occur below the latitude of 40° to 45°. Pennsylvania's forests were too dense. Brushy, open forest with a dependable water supply was not readily available. As Pennsylvania was settled, the forests devastated and open areas created, suitable habitats and an adequate food supply became available and the red fox moved south, increased its ranks, and became thoroughly entrenched. The European red fox, with its slightly shorter, blunter nose,

was probably swallowed up by a process of assimilation and lack of segregation. The red fox of Pennsylvania is almost certainly a native to the New World and a hearty frontiersman in its own right.

The individual range of this fox is not extensive. It is believed that the male may travel over an area of about 5 miles in search of food, but the female probably confines herself to a somewhat smaller home range. They seem to be home-bodies and, if undisturbed, will remain in the same area and even use the same den year after year.

It is amazing how much vegetation this carnivore consumes. The story of the fox and the grapes reveals something of its food habits. Apples, berries, cherries, pokeweed berries, grasses, grains, insects, beetles, grasshoppers, small birds, eggs, mice, shrews, moles, rabbits, and young deer, sheep and pigs are all relished. While the red fox is an avid mouser (and a delight to watch in the act) he will not attack a large sheep, deer or pig. The chances are that when these items are found in his diet it means that he has come across a ready-made meal—in other words, carrion or the refuse from a local slaughterhouse. Chickens, and other domestic fowl, however, he can and does pursue and kill. In all probability the reputation that he has gained for his predation on livestock is greatly overrated by the irate owners of the livestock. When field mice are abundant, and the supply of rabbits is plentiful, Reynard rarely resorts to the dangerous pastime of invading the farmyards.

In the winter the red fox is rather a solitary animal and hunts alone. In January or February, however, the dog fox forgets his solitary ways and seeks his mate. It is fairly well known that the red fox is monogamous but whether he mates for life or only for the year is not certain.

After a gestation period of 51 days 4 to 7 young are born. The litter may contain as many as 10 or more pups, but this is very unusual. The young weigh about 4 ounces each, have woolly, lead-gray coats, and their eyes are tightly closed for the first 8 to 10 days. They remain in the den for nearly a month but when they emerge both the father and the mother take on the job of bringing in food for them. They are weaned at the end of 2 to 3 months but remain with the parents until fall. Only one litter is produced per year. The young may breed the following year.

The den is usually a converted and enlarged woodchuck burrow, with several openings, one of which is quite obvious. Others may be hidden. At the main opening, where the pups play and receive food brought in by the parents, quite a collection of bones, feathers and fur may be found. Sometimes the den may be in a hollow log, or hollow standing tree. On other occasions, the female may dig a burrow of her own. During the winter the den is usually deserted, the fox clothed in its glorious fur coat sleeps in the open, its great, bushy tail protecting its bare nose and paws.

Although red is the dominant color in Pennsylvania, one litter may contain several color varieties in other parts of its range: black, silver, cross and red. As is the case with the black bear and the gray squirrel, names can be misleading. In the north and northwestern portions of its range, more silver and cross foxes are produced than in the eastern sectors. In Pennsylvania a silver, black or cross fox is indeed a rarity, although not unknown.

One curious mutation, or coat variation, is the one known best as the Samson fox, but sometimes called the burnt, scorched or bastard fox. This animal lacks the long guard hairs and remains throughout its career a woolly, nondescript character without adequate protection from the cold of the winter. The fox is worthless. It is told in Judges (15 : 4-5) that Samson, catching 300 foxes, tied their tails together and put a burning brand between them, then sent them out through the grain fields of the Philistines. Little wonder that Samson's foxes had scorched coats!

The voice of the red fox, or rather the bark, is not unlike that of a small terrier. It is usually a short, sharp bark, followed by a yap-yap. During the mating season, long yells, 2 or 3 different sorts of yowls and screeches, and softer churr-churrs may be heard. It has been said that on rare occasions a number of red foxes will congregate and bark in unison—a foxy version of coyotes howling.

The red fox is not particularly difficult to tame but, to put it mildly, it makes an exceedingly active pet! Its curiosity knows no bounds and the only time it can keep its nose out of things is when it is asleep. To leave it alone and loose in a house is to invite utter devastation—everything has to be explored, destroyed or hidden. And to turn it loose outside is to send a whirlwind through the neighborhood. Considering that it can travel 30 miles per hour, and possibly 45 miles per hour at top speed, it is easy to understand why it is difficult to keep under control. With good care Reynard may live to an age of 12 years in captivity, although at 10 he will be very old. Certainly he is not likely to live that long in the wild.

The red fox does not have many enemies in Pennsylvania, if one excludes man. Bobcats, eagles and dogs may take their toll but disease and parasites do much more damage to the fox population. When the fox becomes exceedingly abundant, sarcoptic mange, and sometimes rabies, sweep through the species and decimate it. Fleas and internal

parasites plague the beast, and the ranks thin and dwindle. Then a new cycle starts. The red fox population begins to climb and vigorous healthy stock once more inhabits the fields and forests.

Man is the fox's only real antagonist. Weighing 15 times as much as the fox and armed with all the resources of civilization (plus an opposable thumb), he still finds himself hard put to cope with his wily opponent. Take the bounty system, for instance. There is no evidence whatsoever to indicate that putting a price on the head of the red fox has ever achieved its purpose. They seem to thrive under the bounty system! Nor has the fur trade decimated its ranks. When long fur is in vogue, thousands are trapped each year but the population does not seem to suffer. Certainly hunting with horses and hounds has no effect —except to make for a more vigorous group of individual foxes! No wonder man considers the red fox a wily opponent.

What is it that gives the red fox his reputation? There are many tales told of its sagacity and cunning. For instance, it is widely believed that when encumbered with an over-population of fleas, Reynard takes a stick or wad of dry grass in his mouth, trots to the nearest body of water, and then backs slowly in. Finally, all that remains above water is the stick and a small black nose. The stick is then released, swarming with the fleas that have sought refuge there, the fox swims away, dashes up on shore, shakes himself thoroughly, and rejoices in his freedom from fleas!

Many, too, are the tales told of the manner in which foxes outwit pursuing hounds. Doubling back in their own tracks, running along fence tops, racing through shallow streams, circling the hounds, then sitting on a high knoll to watch with evident enjoyment the confusion of the pursuers. These represent only a few of the attributed strategies! Trappers, too, have their tales to tell of clever foxes which outwit them for years. Farmers add to the legend. Cunning creatures which steal into their hen houses, rob the roosts, and escape without a sound being made—this, in spite of a respected dog on guard and a man with a shotgun hidden behind the nearest tree! And so it goes. The red fox symbolizes cunning, wiliness, cleverness and an ability to fend for himself.

But the fact remains that many foxes do get trapped. Many are taken by hounds, and many are shot by hunters looking for other game. Its curiosity is often its downfall and sometimes concentration is its weakness. A fox concentrating on its pursuit of mice or rabbits may have its traditional guard down and become an easy victim to man. Their devotion to their young sometimes brings them to their doom, for the protective instinct is strong. In the world of foxes there are probably stupid individuals as well as bright individuals. However, all red foxes do *look* intelligent!

It would be a sad day indeed for mankind if the red fox vanished from the face of the earth. He is cursed, cheered, revered, hated and

loved. Economically, he appears on both the debit and credit sides of the ledger. His shrewd and audacious nature excites admiration and challenges his opponents. Long may his bush wave!

Subspecies in Pennsylvania: Vulpes fulva fulva (Desmarest).

Range: Throughout the State.

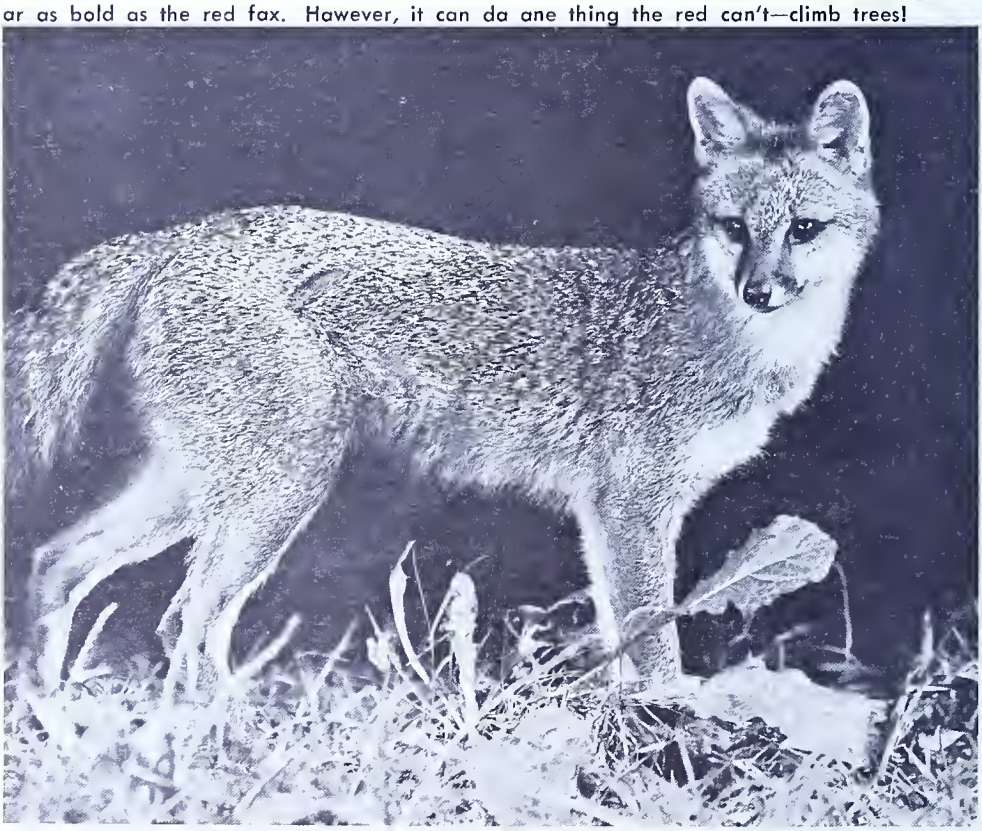
GRAY FOX — *Urocyon cinereoargenteus*

Other names: Tree-fox; wood fox; grayback; mane-tailed fox; cat fox.

The scientific name for this animal is singularly appropriate and very descriptive. The generic name is derived from the Greek words *Uro* and *cyon,* meaning "tailed dog," from the tail, which has a concealed mane of stiff hairs without any soft fur intermixed. The specific name is derived from the Latin combining forms, *cinereo* meaning "ashy" and *argenteus* for "silvered."

Certainly the gray fox lacks the glamor of the flamboyant red fox and there are many reasons for this. For one thing, his coloration, although attractive, is not nearly so conspicuous. Secondly, his preferred habitat is the unbroken forest. Thirdly, he has no inclination to "lead the hounds a merry chase." Fourthly, he slips through the woods and rarely ex-

THE GRAY FOX lacks the glamor of his red cousin. He is neither as colorful, cunning, fast or as bold as the red fox. However, it can do one thing the red can't—climb trees!



hibits the dashing spirit of his red cousin. He has neither the cunning, speed nor strength of the red fox, nor does he need them. He has one saving grace. Alone among the Canids (dog family) he can climb trees. Quite a feat for an animal without climbing feet!

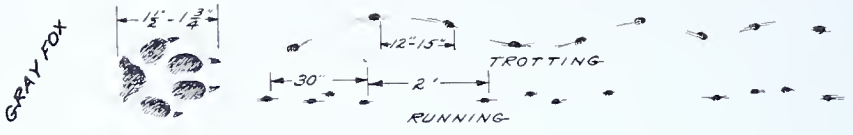
Although the gray fox is just about the same size as the red fox it appears smaller and shorter-legged. The muzzle is relatively shorter and sharper. Its rather coarse coat is predominantly grizzled-gray and black, the stockings are brown or gray, and the tail has a black stripe down its length and a decidedly black tip. The white throat and patches of orange here and there dress him up considerably, but his coat is nowhere near as long, luxuriant and glamorous as that of the red fox. He measures about 3½ feet in overall length, and his weight is about 8 to 10 pounds. His tail carriage is somewhat similar to that of the wolf —angled low and nearly touching the ground.

In contrast to the red fox, this is a southern species. It ranges from South America northward through Central America to the Great Lakes and St. Lawrence River, only in a few places invading very southern Canada. It is strictly an American genus and has never been known in the Old World. It ranges throughout Pennsylvania, preferring unbroken forest, rough rocky country, brushland and abandoned farmland.

The home range of individual gray foxes has not been definitely determined but it would appear that it confines itself to ½ to 2 square miles. During the mating season (late winter and early spring), the males and females will range together and may travel over an area of 4 or 5 miles. Quite likely there are cases of individual variation, for one animal that was trapped and banded was recovered two years later nearly 52 miles from the original point of capture!

The gray fox eats essentially the same food as a red fox. While it probably has decided preferences, the chances are that, like man, it will eat what is easiest to come by. It hunts its home range intensively and vegetable material, apples, berries of various kinds, cherries, wild grapes, wheat, oats, corn and pokeberries are all acceptable. Insects, especially beetles, grasshoppers and crickets are frequently eaten. Of course, being a carnivore, mice, shrews, moles, young rabbits and birds are favored items.

Breeding takes place in February or early March. Although it has not been determined that the male and female mate for life, it seems quite evident that the male is monogamous. He probably plays the same role in raising the litter as does the red fox and remains with the family group until it breaks up in late fall. After a gestation period of approximately 63 days, the young are born. A litter may number from 2 to 7, but the average is 4 individuals. Each weighs about ¼ pound at birth; the eyes are tightly closed; the ears are glued tightly to the head and the coat is gray and wooly. The vixen nurses her cubs for 8 to 10 weeks but during the latter part of this time they are also consuming quite a



bit of solid food, delivered at the den door by the parents. By early summer the young are able to follow their parents on nocturnal hunting trips and by fall the family group disintegrates. Although the young continue to grow until they are 18 months old, they can breed before they are a year old.

The gray fox differs somewhat from the red fox in its choice of a den. Its requirements are relatively simple—a hole in the rocks, a hollow log or hollow tree, a slab pile or even a very simple burrow may do. It uses a den of one sort or another throughout the year and usually has a series of dens, retreats or rock shelters. Unlike the red fox, it will not lie out on a cold day in winter.

Not much is known about the voice of the gray fox, but its bark is similar to that of the red fox, although somewhat coarser. It is also known to growl, snarl and occasionally, yowl.

As a pet it does not take kindly to domestication, and is rarely completely tamed. It remains snappish and seems to mope when confined. It has been said that individuals in the wild have lived 14 to 15 years, but their life span appears to be very short in captivity.

From a sporting point of view the gray fox leaves much to be desired. Imagine how disconcerting it must be to those who ride to the hounds to have their quarry duck into the nearest woodchuck hole or shinny up the nearest tree! A fox simply shouldn't do things like that. He should run wild and free and give his pursuers some sport for their money. If there is a large rock pile available this character is long gone and the hounds may as well give up the chase.

One cannot help but speculate on why this animal, of all the dog family, should take to the trees. Perhaps its preference for unbroken forest may explain it. Gray foxes have been found in squirrel nests and in abandoned hawk nests fully 60 feet above the ground. Their method of climbing varies. Sometimes they will leap up on a low branch, 4 or 5 feet above the ground, then jump awkwardly from branch to branch, progressing upwards till they reach their destination. Occasionally they will utilize the trunk of a partially downed tree, running up it and out into the branches, then leaping off to make good their escape. At other times they will shinny up a vertical, branchless trunk, using the forepaws to grasp the trunk and the hind legs to scramble up. This they do with amazing rapidity. The descent reminds one of a youngster shinnying down backwards. There is some evidence to indicate that the gray fox uses its nails almost as a cat uses its claws in climbing.

Man and his dogs, bobcats and perhaps great-horned owls are enemies of the gray fox. Diseases and parasites, however, are its principal enemies. Although not as subject to mange as red foxes, it suffers from fleas, ticks, lice, and a host of internal parasites such as tape worms and round worms. Periodically rabies sweep through its ranks and occasionally the population is decimated by other diseases.

Economically the gray fox is of relatively little importance. The fur is too coarse to be used for much of anything except trim, although for awhile the tail was in great demand by the younger set. What was a hot-rod or bicycle without a fox plume flying from it! Because of its preference for the woods it does not plunder the barnyard to any great extent. Since it will not run far or well before the hounds, it has little appeal to the sportsman. However, it does respond well to a mechanical predator caller.

We are likely to have the valiant, shy gray fox around as long as we have Penn's Woods.

Subspecies in Pennsylvania: Urocyon cinercoargenteus cinereoargenteus (Schreber).

Range: Throughout the State.

BLACK BEAR — *Ursus americanus*

Other names: Cinnamon bear; brown bear; bruin.

Although big, heavy-set and cumbersome in appearance, the black bear might just as well be known as the "phantom of the woods" as the "clown of the woods."

It is common knowledge that many huge, fat men are excellent dancers and exceedingly light on their feet. So it is with our bears. Many a hunter has searched for a glimpse of this quarry but has returned from the hunt, year after year, discouraged and disgusted. There were bears in the woods all right, but where? The answer probably lies in the character of the animal itself.

The bear is the largest carnivore in the State. Its total length is 60 to 65 inches, with a tail averaging approximately 4 inches. A fully adult animal may weigh from 200 to 400 pounds, with exceptional specimens going as high as 600 pounds. The fur is thick and glossy in the winter, and a healthy bear may have 4 inches of fur overlying 4 inches of fat when it goes into hibernation. In Pennsylvania bears are usually black, but there are many variations in color. Brown, cinnamon or red specimens have been taken and all three colors *could* be present in the same litter.

In appearance the bear is cumbersome. The hindquarters are higher than the forequarters; it is close-coupled, stocky and flat-footed. The

THE BLACK BEAR is the largest carnivore in the State. Its total length is 60 to 65 inches, with a tail average of about four inches. An adult may weigh from 200 to 400 pounds, with an exceptional specimen going as high as 600 pounds. Pennsylvania bears are usually black, but there are many variations in color.

head is rounded with a bluntly pointed snout and the ears are small and erect. The eyes are small and wide-set and not particularly keen. An excellent sense of smell and impressive ability to hear compensate for its nearsightedness. There is enormous power in the chunky hindquarters—power which gives the animal speed and agility. The bear has been clocked at 28 miles per hour, just under the 30 miles per hour credited to the deer! What is more, a bear can hump itself up a tree with amazing dexterity, often circling the trunk as it climbs. (Grizzly bears are not so fortunate—only the cubs can climb.) The descent is always tail first and individuals frequently let go when they are still some feet from the ground. Down they thud on well-padded rears, roll over and take off in high gear.

But what about the hunter and his elusive quarry? Well, the bear has far better ears and nose than man, even though his eyesight is not very good. A bear may be moseying through the woods when suddenly the stench of man assails its nostrils. Alert and shy, it stops in its tracks and sniffs the air until it is sure of the direction in which the danger lies. Then it is gone—in the opposite direction. But its bad eyesight sometimes betrays it and this accounts for some of the close encounters people have had with bears. If the wind is in the right direction a person may unwittingly approach a bear which is concentrating on something

else. The result can be extremely funny. Up on its hind legs goes the bear with a loud woof and takes a careful look and comes down running —in the opposite direction. The human usually does exactly the same thing! Of course it is not so funny when a near-sighted bear wanders into a picnic, completely beguiled by the smell of tantalizing weiners and hamburgers. During the hunting season, though, the bear is on guard as the first wave of hunters invade its domain and a more wary and agile opponent a hunter could hardly wish to stalk.

The black bear is most at home in forested hills and valleys where he finds foods and protection. Therefore, in Pennsylvania it is most common in the northern counties of the State, especially in Potter, McKean, Tioga, Elk, Cameron, Lycoming, Clinton, Pike and Monroe. However, it does range along the mountains as far south as Cambria, Bedford, Fulton and Westmoreland counties.

For such a large mammal the bear eats an amazing amount of small material. Blueberries, fruits of the shad-bush, raspberries, acorns, beechnuts, apples, corn, ants, grubs, salamanders, mice and any other small fry he can capture make up the bulk of his diet. Bruin is omnivorous, and his food supply would comprise a catalogue of almost all the edible fruits, nuts, berries, grain, seeds, roots, inner bark of trees, as well as the flesh of any animal he can capture or find dead. The bear's love for honey is legend, and frequently brings him into mortal combat with man. Occasionally an individual may run amuck and become devoted to a diet of small porkers or lambs, but these cases are the exception rather than the rule.

For the most part bears are solitary animals, and it is rare to find many together, although a mother and her cubs may operate as a unit for a rather lengthy period of time. However, in late June or July the males go on the prowl, and noisy, rather brief courtships take place. This is followed by a gestation period of 6½ to 7 months and, when the cubs are born, the female is already in her winter sleep. In late January or early February 2 to 5 underdeveloped, tiny blind bears arrive on the scene. Although covered with fine, close, dark hair, it is so thin that they are practically naked. For its size, the female bear produces remarkably small offspring which weigh only about ½ pound apiece. It is 40 days before they open their eyes.

During all this the female snoozes quietly along, shifting her position slightly when the occasion demands. People sometimes stumble upon and observe the drowsy animal and it often takes real ingenuity on the part of the Game Protectors to save the bear from the cruel inquisitiveness of humans.

After 70 days the cubs are ready to leave the den. They weigh about 5 pounds apiece and are still nursing, although they are beginning to eat some solid food. By August they are weaned. They may or may not stay with the mother during the next winter. By the end of the year they will weigh from 60 to 100 pounds, or more.

Bears are rather haphazard in their choice of den sites and may select a hollow log, cave or a mere depression in the ground. Anything or any place that will afford them some protection from the cold and the snow is sufficient. The males are even more careless in their selection. Bears are not true hibernators in the real sense of the word and there is good evidence that the sleep is not profound. Tracks around den sites indicate that there are periods of wakefulness. But in Pennsylvania, during a cold winter at least, bruin will sleep most of the time.

Little cubs are about as attractive, mischievous, cute balls of fuzz as can be found in the animal world. They are a constant source of alarm, annoyance and probably pride to their mother, and she disciplines and protects them with the deepest devotion. Their curiosity knows no limit and gets them into all sort of predicaments. The female does not "spare the rod" and when her unruly young ones get out of hand they receive many a resounding slap from their mother's paw. If things get rough she sends them up a tree, bawling or whining all the way. They whimper like children when frustrated and growl like miniature grizzlies when wrestling with each other. The positions they assume when relaxed or playing seem almost impossible. Even the adults seem to like to roll and tumble, and the use of their forelegs is exceedingly human in many respects.

Bears make a variety of sounds. They whimper, whine, sniff, bawl, and growl. When surprised they often give a loud "woof" or snort of

BEARS ARE CLIMBERS and it is not unusual to see bear "sign" scratched into the sides of beech trees. These marks are lasting evidence that the black bruins inhabit the area.

surprise and, on the defensive, their cough of menace means business. But on the whole, they are not particularly noisy animals. Sometimes, when the urge to eat leads them to tear up a wormy log for the goodies encased therein, the woods may resound with their efforts. Or, if the urge for honey leads them to raid a honey-tree, the resulting stings may result in loud bawls and thrashing around. The stings, however, seldom make them deviate from the delicious nectar which they are seeking.

On the whole, bruin is an amiable creature—good natured and mild tempered. Combined with these characteristics are alertness, shyness, wariness and curiosity. In defense of its young, or when wounded, the bear may be aggressive. In captivity, its temperament can only be termed uncertain. On the whole, its philosophy can be summed up in these terms: "when in doubt, run." While there are on record a few accounts of unprovoked attacks on man, these are most certainly rare exceptions.

Adult bears have a rather extensive home range, some individuals covering as much as 16 miles during a single night. Well developed bear trails are followed and along these, at irregular intervals, one will find the controversial marking trees. These trees bear the scars of claw marks as high as an individual bear can stretch on its hind legs. Whether this is done to sharpen the claws or to enable the bear to stretch his muscles thoroughly is not known. More likely it is like the urinating spots of other species which denote territorial rights or act as information posts to those who follow. It is not known whether each tree is the property of a single individual or whether the same tree is used by a number of bears.

The bear is an excellent and powerful swimmer and does not hesitate to cross wide rivers and lakes. Many a man has found to his sorrow, however, that it is unwise to try and head off the furry voyager. It has been reported that on many an occasion the bear has boarded the pursuing boat leaving the previous occupant either in the water or crouched at the far end!

Because of its habit of rooting under rotten logs, stumps and rocks, the bear is often likened to a pig. The males are known as boars, the females as sows, and the young as cubs.

Pennsylvania is fortunate in having perhaps as many as 1,500 or more bears roaming its forest. The annual take by hunters may run between 300 and 500, sometimes more. It does not seem likely that regulated

hunting will decimate their ranks and, although parasites and disease take their toll, the population seems to remain about stable. In the wild, bruin probably lives from 10 to 20 years. In captivity individuals have been known to live for 35 years. Although its meat may be exceedingly good, its real value to the hunter lies in its worth as a trophy.

Subspecies in Pennsylvania: Ursus americanus americanus Pallas.

Range: Throughout the State in wilder or more wooded sections.

RACCOON *Procyon lotor*

Other names: Coon; ring-tail.

The scientific name of the raccoon, *Procyon,* means before (pro) dog (cyon); the specific name means "washer" (lotor). Very loosely, the implication of the generic name is that the raccoon is more primitive than the dog in the evolutionary ladder; the specific name refers to the coon's well-known habit of dunking its food in water.

Like so many of the State's mammals, the raccoon's appeal varies according to individual prejudices. In the frosty evenings of fall nothing so delights the hearts of certain enthusiasts as a good pack of hounds and a running coon. The throaty baying of eager dogs with their prey perched high in a tree is a soul-satisfying experience that little else can duplicate.

To the trapper the pelt is the thing. To be sure, the trapper must know his quarry's habits thoroughly to do a good job of trapping, but beyond that it is a coldly impersonal affair.

Still another group exists—largely in suburbia—who make their first acquaintance with the masked robber when their garbage cans are raided night after night. To some, the nuisance value is offset by the thrill of seeing this wild mammal for the first time. To others, the only important thing is to get rid of the marauder.

There is certainly a great deal to be said in favor of the raccoon's appearance. He is a delightful looking character, about 31 inches long, with a bushy, ringed tail approximately 10 inches in length. He is a robust, long-pelaged animal, with a long slender muzzle and a head broad across the jowls. His ears are erect and prominent, and across his bright eyes and forehead there is a black robber's mask which gives him a peculiarly mischievous appearance. His overall coat is grizzled gray, brown and black, but the muzzle and back of ears are pearly gray. In weight he may vary from 12 to 26 pounds, and an occasional specimen may go as high as 40 pounds.

You may look for him almost anywhere in our State, both in well-populated cities and primitive areas. In general, forested areas are pre-

ferred, so long as plenty of water is available as lakes, streams or marshes. He is almost strictly nocturnal and is rarely seen during the day.

Like so many other carnivores, the raccoon is practically omnivorous. It is particularly fond of frogs, fish, shell-fish, small mammals, birds, eggs, reptiles, insects, fruit, nuts, corn, etc. They seem to get a real pleasure out of wandering along a stream bank and dipping for succulent crayfish in the shallow waters. While it is generally believed that coons feel the necessity for washing everything they eat, this is probably not the real reason for this strange habit. It is much more likely that it is purely a tactile affair. Pet coons are likely to carry this habit to rather ridiculous extremes. Crackers, bread and cookies just don't lend themselves to protracted dunking and kneading in the drinking bowl. When tactile satisfaction has been achieved there is nothing left to eat!

Under ordinary circumstances the raccoon is a relatively silent animal, but it is capable of a rather wide variety of sounds. When angry or on the defensive its snarl and bark closely resembles that of a dog. When an intercoon squabble takes place it is usually accompanied by querulous "churrs." A tame coon, when begging for food or attention, makes a whining "err-err-err" sound.

In Pennsylvania breeding takes place usually in January or February, and normally the female breeds at one year of age. Although raccoons apparently do not mate for life, the male of the year remains with the female until the young are born and he sometimes assists in the

THE RACCOON may be faund in nearly every area af the State. Caurageaus and cunning, inquisitive and wary, tenaciaus and dynamic, the raccaan gaes its merry way.

feeding of the young. After a gestation period of about 63 days the young are born. The number may vary from 3 to 6, but the usual litter is 4. By June, the young are able to leave the nest for short excursions but another month will elapse before they can join the mother on regular hunting excursions. The female is a devoted and aggressive mother and will defend her young with vigor. The available information indicates that if a female misses the January breeding period she may breed a month or so later. This would account for very small coons being observed at a time of the year when most of the young of the year are at least half grown. When the young are born they weigh about 3 ounces and it is 19 days before their eyes are open. Opinions differ, but it would seem likely that the young are weaned sometime before they are 3 months old.

The favorite den site is high in the hollow bole of a tree, but if such a den is not available many other sites are utilized. A hollow stump may be taken over; a small cave in a rocky ledge, a hollow log; or even an abandoned woodchuck burrow may provide an adequate nest. Although raccoons are prone to lead solitary lives, they are not unsociable. Some den trees are shared by as many as 10 individuals during the period when they are in semi-dormancy.

The raccoon is not a true hibernator, but it does sleep during a good part of the coldest time of the winter. In the fall, in the northern part of its range, the layer of fat becomes very thick and the coat heavy and glosssy. By early spring the raccoon is a different looking animal and is quite emaciated. At that time it must find food or starve to death.

How long they can live in the wild is anyone's guess, but in all probability a 10-year old animal would be an exception. In captivity they have survived 15-18 years.

Weight, too, varies exceedingly. Very large animals may be light and not weigh more than 10 to 12 pounds. On the other hand, a small, but very fat animal may weigh 15 to 20 pounds. People are prone to exaggerate the size and weight of animals and enormous coons are frequently mentioned in newsclippings. However, careful research has revealed that most of the weights were guesses, and probably only one coon in 100 goes above 25 pounds in weight. Forty pounds is extremely heavy.

Man and his dogs are the raccoon's greatest enemies. The dog alone is not too formidable and a mature coon can sometimes rout several dogs.

They protect themselves by seizing a dog about the throat with both front paws, ripping at the underparts of the dog with their hind legs and tearing viciously with their teeth. If the encounter takes place in water, the dog will frequently be drowned. The young may become victims of big owls, bobcats, and foxes.

Approximately 100,000 coons are taken annually and legally in Pennsylvania by trappers and hunters and many more perish on our highways. Disease and parasites take their toll also. Raccoons have their ups and downs usually due to some infectious disease, but in recent years they have been generally abundant.

Courageous and cunning, inquisitive and wary, tenacious and dynamic, the raccoon goes its merry way. Its vices are few, and when it becomes troublesome it is not difficult to eliminate. For sport and profit, as well as esthetic enjoyment, it is a vital part of our natural resources.

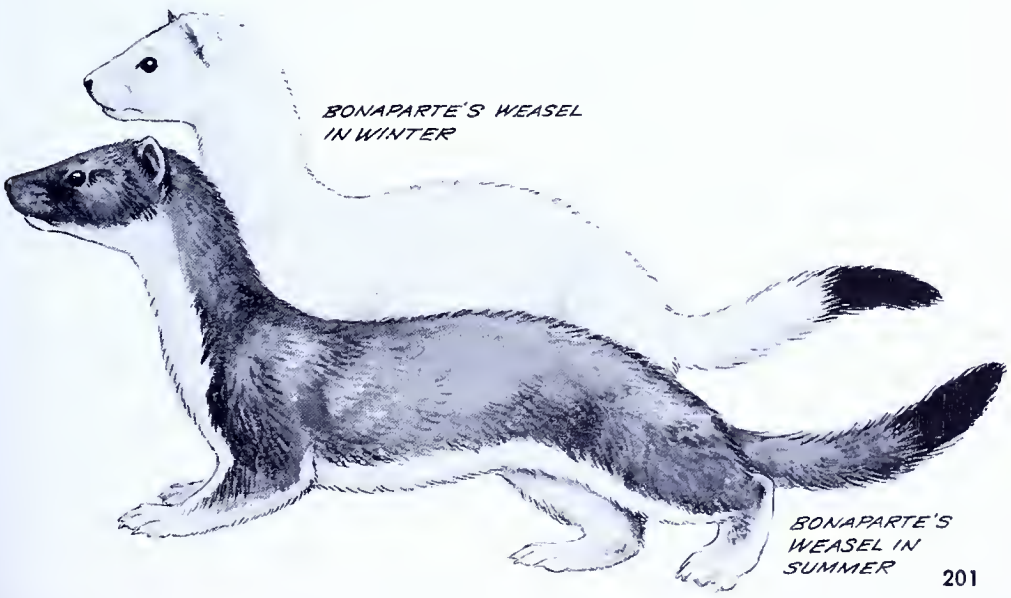
Subspecies in Pennsylvania: *Procyon lotor lotor* (Linnaeus).

Range: Throughout the State.

ERMINE ***Mustela erminea***

Other names: Short-tailed weasel; Bonapartes weasel; small brown weasel.

Ermine is royal fur indeed. Down to the present day royalty has been robed in scarlet trimmed with ermine. The dazzling white edging is the winter coat of *Mustela erminea,* the black tabs are the ends of their tails. Aside from the length of tail (less than 44 percent head-body length) and its smaller size (males, chipmunk-size; females, field mouse size) the ermine and the long-tailed weasel are almost identical in proportions, color and pattern.



This is the animal that the English call the stoat and it ranges from the British Isles across Europe, northern Asia, all of Canada and Alaska down to the central United States. Unlike the long-tailed weasel which inhabits the American tropics as well as Penn's Woods, the ermine is a cold weather beast. It follows the Appalachian Highlands a short way into Dixie but leaves the lowland cotton fields to its long-tailed cousin.

Although this weasel is present throughout the State with the possible exception of the southwestern corner, it is not common. During those years when weasels were on the bounty list, about one ermine was probated for every 15 long-tails.

As befits its Arctic origin, all short-tailed weasels turn pure white in winter. The terminal third of the tail remains black, however, and forms a striking contrast. A weasel, any species of weasel, in white winter pelage is a beautiful creature.

The food habits of the ermine parallel those of the other weasels. Freshly killed meat is the main dish served with a few invertebrates on the side. Its intermediate size would seem to suit it for larger game than that taken by the mouse-sized least weasel. Perhaps these three small slayers have avoided direct competition by focussing upon different sized groups of prey—not in any clear-cut fashion—but merely according to their capabilities.

Breeding habits are similar to those of the long-tailed weasel; delayed implantation producing an extraordinarily long gestation period of up to 9 months in length. Females (including females of the year only 2 to 3 months of age) come into heat during July or August. Males (at least in the British Isles) are impotent most of the year—late summer to early spring. This may not be necessarily true of our local subspecies, however.

Care and feeding of young coincide with those of the long-tailed weasel. The newborn young weigh 1½ to 2 grams at birth (1-1/16 of of an ounce, or 256 to the pound). At two weeks of age the nestlings have a decided mane on the back of their necks which the young of the long-tailed weasel lack. They grow rapidly and in several months' time are full grown.

Subspecies in Pennsylvania: *Mustela erminea cicognanii* Bonaparte.

Range: Throughout the State except the southwestern corner.

LEAST WEASEL — *Mustela rixosa*

Other names: Mouse weasel.

Teeth like tiny thorns, a skull the size of a jelly bean, and a body no larger than a mouse, this is the smallest carnivore in the world. In its grassroots jungle it lives by fang and claw, an active precarious existence.

It must hunt for a living and by doing so, exposes itself to a frightening array of predators, from larger species of weasels, snakes, owls and alley cats up to bobcats and even bears. The least weasel is a rare animal in Pennsylvania.

Despite the fact that its habits would almost seem to invite disaster from every quarter, the mouse weasel, as it is sometimes called, has an enormous range. It is found from the mountains of North Carolina

LEAST WEASEL

north throughout the Canadian arctic to Alaska and possibly (if the very similar Eurasian weasel *Mustela nivalis* is in reality our least weasel as some zoologists believe) all the way from Siberia to the British Isles.

The least weasel weighs from one to two ounces which means that some adults may actually be lighter than their meadow mouse prey. A typical weasel, with its long slim body and tiny legs, might yet be mistaken for a mouse at first glance. It is sometimes caught by the cat and proudly presented on the back porch as just another mouse. But the gleaming little white underparts (sometimes rather spotted) and short, hairy tail will identify it.

An adult male least weasel will measure 8 inches in length including the tail. Females are slightly smaller.

Large male least weasels may be as large as some small female ermine *(Mustela erminea),* but the tail of the least weasel is shorter than 1½ inches and never black at the end (there may be one or two black hairs but no more). The tails of the ermine and the long-tailed weasel *(Mustela frenata)* are much longer and look as if they had been dipped in black paint.

Captive least weasels are nervous, alert little animals, ready to do battle at the slightest provocation. Fed living mice, they attack with liliputian fury, grabbing the mouse by the base of the skull with an

audible crunch and hanging on like any African lion until struggle ceases. One caged least weasel required an average of a gram of food per hour. This translates to a mouse per day, 40 per cent of the weasel's weight. By feeding the animal stained mice it was discovered that food passes through the digestive tract of this active little carnivore in just 3½ hours.

Aside from a few observations such as these we have little definite knowledge of this tiny weasel. It is too small to master anything much larger than a mouse or a sparrow but may supplement its diet with insects as other weasels do.

Its breeding habits seem to be quite different from other weasels. Rather than one annual spring litter, as in the long-tail and the ermine, multiple litters are suggested. Young with unopened eyes have been found in winter. Females with young have been taken in October, January and February. The gestation period is apparently not arrested for months as in the other weasels where delayed implantation seems to be the rule. The closely related Old World *Mustela nivalis* also does not have delayed implantation. It is believed to have two annual litters. One would think that these tiny mouse-sized weasels would have to replenish their ranks at a much faster rate than the larger carnivores in order to survive at all.

The term "rare" when applied to wild animals usually means nothing more than the fact that it doesn't cross man's path very often. It may actually be quite common. The little spring peeper *(Hyla crucifer)* would seem an extremely rare animal if it were not for the fact that each spring they sing by the thousands in roadside ponds. The rest of the year, one is seldom seen.

In these terms, then, *Mustela rixosa* is our rarest weasel. During those years when weasels were on the bounty list with a price on their head, less than one per cent of all those turned in were least weasels—about 60 or 70 a year. They are most common in the northwestern and southcentral portions of the State, scarce in the Ohio Valley area and do not occur east of Harrisburg, or if so, must be rare indeed.

These mighty mites are active in all weather. They hunt mice in the snow, leaving miniature food caches like their larger brethren. They have been seen carrying mouse carcasses and sometimes have been caught bedded down in nice warm mouse fur.

A few other facts—some may turn white in the winter; the home range has been estimated at less than two acres, although nobody really knows. Beyond this, we know little except that it is the world's smallest carnivore and one of the least studied of the mammals.

But *Mustela rixosa,* despite its hazardous life has been with us for at least 12,000 years and probably more. Its mouse-sized little bones

and wicked sliver-like teeth have been recovered from cave deposits in the State dating back to late Pleistocene times.

Subspecies in Pennsylvania: *Mustela rixosa allegheniensis* (Rhoads).

Range: Western and central parts of the State, absent from the northeastern and eastern sections.

LONG-TAILED WEASEL — *Mustela frenata*

Other names: New York weasel; large brown weasel; ermine.

The long-tailed weasel heads the agenda in all survival courses for rats. The animal is tailor-made for rat holes, popping in and out with such terrifying preoccupation that it soon puts itself out of business in one burrow system and is forced to move on to the next. It can and will take to the high rafters if occasion demands to pull down a rat who "takes to the hills."

Weasels kill with silent efficiency, pouncing with snake-like speed, the cobra-like head striking for the base of the hapless victim's skull, the long body hugging tightly until the fangs have found their mark. Flowing through a burrow like quicksilver, they are death itself, quick, efficient, and inescapable.

This is our largest and most common weasel. During those years when bounty was paid on all weasels, 8 out of 10 were the long-tailed.

If you took a rat, pulled it out like taffy while shortening its limbs, then you might be able to call the long-tailed weasel rat-sized. Some

large males may reach a half-pound in weight and closely approach a small mink in size. Weasels (except for an occasional mouse-sized least weasel) have snow-white underparts. Mink are an overall brown with maybe a white spot or two on the throat.

Female long-tailed weasels are much smaller—chipmunk-size and present a problem in identification. They are almost identical in size and color with the male ermine (the female ermine, again smaller than her mate, is mouse-sized). There is a rule of thumb to be applied here. If the tail is more than 44 per cent of the head-body length you have a long-tailed weasel; if it is less than 44 per cent you have the ermine or short-tailed weasel. Both the long-tailed weasel and the ermine have the last one-fourth of their tails jet black, a character which will differentiate them from the tiny least weasel.

The long-tailed weasel is a southerner; the other two Pennsylvania weasels are northern in their distribution, occurring from Alaska south to the central states. But *Mustela frenata* occurs from Maine south to Mexico, Central America and South America. The three species overlap in the Great Lakes region and the central Appalachians. Only a handful of states can boast of as many species of weasels as can Pennsylvania—a distinction which might be somewhat questionable—for weasels have traditionally been regarded as unsavory little characters. There is no doubt that they are efficient killers and that they may let their instincts get the better of them in a poultry run. But weasels as rodent killers have a part to play in nature.

The weasel is one of the natural "controls" of wild rodent populations and does far more good in its relentless pursuit of the solution to the "population explosion" among the rodents than it does harm. Though primarily a mouser, the long-tailed weasel will tackle anything that moves and is small enough. They are just barely large enough to pull down an adult cottontail. Young rabbits, of course, are fair game but their success with old ones is rather spotty. If the initial attack is unsuccessful, the rabbit can easily save itself by flight. At least one rabbit is known to have killed an attacking weasel with its rapier-sharp hind claws. Once an attack has begun, it becomes a hard job to distract the weasel from its victim. One woman, seeing a weasel attack and kill a rabbit on her lawn, simply walked up and plopped a minnow trap over both rabbit and weasel.

Rats, mice, rabbits, squirrels, small snakes, frogs, insects, birds—all are on the bill of fare. After a kill has been made the weasel may eat a

WEASEL
IN THIS ARRANGEMENT HIND PRINTS OBLITERATE FRONT ONES
ABOVE PATTERN RESEMBLES SMALL RED SQUIRREL'S BUT HIND FOOTPRINTS ARE CLOSER TOGETHER

little brain or lap (not suck) a little blood, then curl up for a brief snooze before finishing its meal. The prey may be consumed on the spot or dragged to the den if there are young to be fed. Long-tailed weasels have been seen dragging animals as large as snowshoe hares by the throat.

Weasels, unless they are raising a brood, rarely stay put. Like all hunters they are nomads. When the rats are gone from the corncrib, or meadow-hunting is no longer profitable, it moves on, poking into every cranny, threading each labyrinthine passage of log-pile or stone wall to emerge sooner or later with a mouthful of warm mouse. But the weasel will be back in a few weeks or months to check these now deserted sites again, if he's lucky. For the open life of a hunter exposes the weasel to many dangers.

Captive weasels require about one-third of their body-weight daily to sustain themselves—some 2 or 3 mice a day (or "a reasonable facsimile thereof") every day of the year. Hunting continues throughout the winter and weasel tracks through the snow are a common sight.

Like other weasels, the long-tailed, save for its black tail tip, turns white in the winter. At least some of them do. It can't quite shake its southern heritage. In Maine or New Hampshire all may turn white. But in Pennsylvania 5 out of 6 long-tailed weasels will remain brown all winter. In the southern United States all remain brown-backed throughout the year. Those that stay brown undergo the same annual moults as do those that turn white, the new coat remaining brown. Although length of daylight acting upon the pituitary gland through the eye is suspected of influencing time of moult, there may be some genetic factor at work as well. Southern animals transported to northern areas and reared there will not turn white. Northern animals taken into the south will turn white no matter how mild the winter.

One annual litter arrives in May. Five or six young are born in an undeveloped state, hairless and with eyes and ears shut tightly. They tip the scales at about 3 grains each, which is less than a hummingbird weighs. Hungry and noisy, sounding like little kittens, they spend the first 5 weeks of their lives bedded down in soft fur supplied by their mother's hunting prowess, perhaps in an abandoned chipmunk burrow or deep inside a hollow log. One lucky tribe was reared in a bag of feathers in a farm cellar. The fifth week finds them bright-eyed, weaned, furred and ready to meet the world.

Two or three months after the young are born, females come into heat. The fertilized eggs go through a short period of development until they reach the blastula stage. Then all development ceases until spring when development resumes about 25 days before the young are born. This condition known as delayed implantation is also found in other

(but not all) members of the weasel family. The gestation period of the long-tailed weasel may vary from 103 to 337 days with an average duration of 279 days. Delayed implantation assures that all litters will arrive at that time when hunting is easiest and at the same time does not restrict the mating period to any one short span, thus assuring that more females will bear young. In the case of such an active far-ranging little carnivore, such a device is apparently necessary to achieve full reproductive capacity.

Although weasels are usually nocturnal they are often seen during the day-light hours. It pops in one hole, out another, sits up like a prairie dog, all with lightning-like movements and a fluid grace. Because of the speed with which it pops up and down from one hole to another, weasels are reputed to be able to "duck" a bullet or a shotgun blast. They can't, but they can *almost* do it!

Weasels are unable to duck a trap in any case. In 1915 the Game Commission put a price on their heads and, for the next 20 years, over 50,000 were submitted for bounty annually at an average of $1.00 per skin. The number probated varied with current fur prices but there appeared to be a drop in weasel numbers during the 1940's that was reflected in trapping returns. This drop, due to unknown natural causes, made more of an impression than did decades of bounty-induced trapping. Observations such as this, plus a more realistic evaluation of the role of the predator in a natural community, influenced the Game Commission to remove the weasel (all species) from the bounty list. Fur prices reached a peak during the winter of 1947-48 when a large male long-tailed weasel brought $3.50 and the average price was well over $1. Now weasels bring a much lower price. Only 2,572 crossed the counters of Pennsylvania fur buyers in 1961-62, one for every 1,500 muskrats.

Despite respite from the trap, weasels lead a hard life. Constant exposure to the elements, automobiles, foxes, hawks and owls, the larger snakes, wild cats and house cats, hunters, natural accidents, parasites and diseases cause constant mortality. Carnivores are especially prone to parasitism. Weasels eat the entire carcass, meat, bone, fur and viscera of a wide variety of animals, birds, often fish and insects, and acquire a variety of internal parasites.

The long-tailed weasel possesses the potent anal glands common to all members of the family but they are not as highly developed as the defensive (pretty offensive too!) weapons of the skunk.

Subspecies in Pennsylvania: *Mustela frenata noveboracensis* (Emmons).

Range: Throughout the State.

MINK *Mustela vison*

Other names: None other in common use.

Underneath the luxurious fur coat of the mink lurks one of the most efficient predators of Penn's Woods. This active little carnivore, actually a semi-aquatic weasel, is about the size and weight of a large squirrel. Adult males are just short of 2 feet in total length, including an 8-inch tail. They average 1½ pounds in weight but may reach 2 pounds. Female mink are some 15 per cent smaller than the males and a half-pound lighter.

Mink are found over most of the northern hemisphere both in the New World and in the Old. They prefer forested areas.

Active throughout the year, usually in or near the water, the mink has good use for its fur coat. Thick, full and soft, mink fur has a rich gloss to it. The arrangement of the overlapping scales along the shaft of each guard-hair is such that they reflect light rather than scattering it, enhancing the deep chocolate-brown of the pelt. Half-grown young are a little duller than their parents. Female skins though smaller are silkier than those of the male and are more desirable for the manufacture of fur coats. Large male skins are more often used for trimming.

Mink have been grown commercially for years. Many color varieties of "mutation mink" have been perpetuated by selective breeding. Although farm-bred mink are now superior to wild mink in the eyes of the fur-fashion world and may command over twice as much money per pelt, the demand has been such that prices of prime wild mink pelts have always remained high.

As with all furbearers, mink skins to be commercially valuable, must be "prime"—the luxurious winter coat fully matured. Mink are among

MINK, o semi-oquotic weosel, is one of Pennsylvonio's most efficient predotors. About the size ond weight of o squirrel, they ore found over most of the northern hemisphere.

DURING A RECENT MINK TRAPPING SEASON, eight thousand pelts were purchased by dealers at an average price of $7.28 per pelt. Like other weasels, it has scent glands.

the first of our furbearers to acquire their winter coat. And most mink are prime by November. One look at the flesh side of a skin will tell you. If the hide looks clear and white, it is prime; if the hide is splotched with black (pigment of hair still growing), then it is not yet in its prime.

During the winter of 1961-62 fur dealers in Pennsylvania purchased 7,999 pelts at an average price of $7.28 per pelt—only $3 cheaper than that of a beaver, and $6.50 more than that old standby, the muskrat.

In addition to being an indispensable part of high society, mink can "put on airs" in other ways as well. Like all members of the weasel family (this includes the skunk), they have powerfully scented anal glands. In times of stress, or when the trapper's knife slips, this scent may become all too obvious. The mink cannot aim and spray like a skunk, and the discharge does not perfume the air for days, but the smell is distinct and strong.

Mink are found throughout the State. They appear to be scarce in the southeastern counties. If fur returns are indicative of anything, Pennsylvania trappers average one mink for every 45 muskrats. They are uncommon enough that the sight of a wild mink working its way along some stream bank is long remembered.

Mink and fishermen appear to have an affinity for one another and often tangle ludicrously. One "Isaac Walton" actually caught a mink on a cast intended for a trout. Mink have stolen catches that were

incautiously laid on the bank behind the angler. One amazing story told by E. W. Nelson, formerly Chief of the U. S. Biological Survey, concerns a mink's audacity and a fisherman's ingenuity. Seeing the mink dining on his catch, the fisherman set a small steel trap on the bare ground. Gingerly dragging the fish by the tail with one hand, he held the chain of the trap in the other. The mink followed the fish and was promptly caught.

Although not as aquatic as the otter, mink spend a good deal of their lives close to water. They are tireless wanderers and may turn up almost anywhere, but the shores of unpolluted water courses are their normal habitat. They have no fear of water and can swim and dive with ease. They are quite capable of catching a fish in its own element.

A mink burrow, which may be an abandoned woodchuck tunnel far from water, is usually right on the water's edge beneath a maze of tree roots, under a pier, or deep under a log pile. Occasionally a mink will utilize an unused muskrat lodge or a hollow log. A crude nest lined with dried grass, feathers and fur of its victims is constructed. Burrows in suitable locations may have more than one entrance.

Mating takes place in early spring, usually February or March. The gestation period may be as short as 39 days or as long as 76. Its exact length is subject to several variables. As in some weasels, "delayed implantation" may occur. The embryos start their development, then remain dormant until late spring. Approximately a month after development has begun again, birth takes place. The factors responsible for the resumption of fetal development are not known, but it is suspected that they are the same factors which initiate the spring moult. The earlier in the spring the mating takes place, the longer the gestation period will be, and vice versa. Yearling females and those with smaller litters, tend to have longer gestation periods. The average is some 51 days. This is a modified form of delayed implantation that is seen fully developed in the larger weasels.

Young are about 3½ inches long at birth. They are blind, hairless, and weigh only ⅕ of an ounce. There may be anywhere from 2 to 7 in a litter. The usual number is 4. In 2 weeks they are fuzzed out in reddish-gray hair. Their eyes open in 5 weeks. A week or two later they are out foraging and learning to hunt. By late summer the family has dispersed.

Mink are sexually mature at the age of 10 months. They are lucky if they survive into their second winter in the wild, but fur-farm mink have annual litters for as long as 11 years.

Hunting groups of mink are composed of the female and her litter. Some say that the male mink may stay on and assume his share of the domestic duties for a while. Others state that the male, as in captivity, is polygamous and that the female will likewise accept several suitors.

Male mink may fight ferociously during early spring if they find themselves calling on the same female at the same time.

Mink are naturally bold animals. Tough as wire, they hunt with dogged determination, covering miles of streamsides in a single-minded search for food. All food is animal in nature but availability governs which animals are most commonly preyed upon. In one time and place, crayfish may head the menu; in another, muskrats, mice, or fish. Insects are readily eaten as are rabbits, birds, snakes, shrews, moles, frogs—just about any animal small enough for it to handle. Mink have even been seen jumping at the throats of deer fawns.

Mink kill rabbits and muskrats with ease, and a mink in a chicken coop, like a wolf among sheep, may slay right and left until nothing more moves. Mink may store carcasses during the winter, revisiting such caches to feed. This may consist of a single slain rabbit buried under the snow or as much as "13 muskrats, 2 mallard ducks and 1 coot."

In a muskrat marsh, mink, with their ability to pursue both above and below the surface of the water, are "Public Enemy No. 1," but there have been several cases where a female muskrat with young has actually beaten off a mink's attack. Any dog who has ever tried to tree a cat with kittens can sympathize.

Two races or subspecies of mink occur in the State. The common lowland race *(Mustela vison mink)* is widely distributed. The rarer upland race *(Mustela vison vison)* is restricted to the mountains. It is smaller, darker and silkier than the lowland form. Its exact distribution within the State has not been mapped, but intergradation of the two forms is extensive.

The mink may be a beady-eyed killer, but it is part of the natural scene. It kills many more rats than it ever does chickens (a lot of chickens can be purchased for $58,211.00—last year's fur returns for Pennsylvania mink), and it does not become abundant enough in the face of annual trapping pressures and natural hazards to constitute a serious predator on game.

If it were not for an occasional mink in his trap, the life of a muskrat trapper would be dull indeed!

Subspecies in Pennsylvania: Mustela vison mink Peale and Palisot de Beauvois.

Range: Eastern and western parts of the State; on both sides of the range of *Mustela vison vison.*

Mustela vison vison Schreber.

Range: From the New York line in northeastern Pennsylvania it follows the mountains southwestward into West Virginia.

SPOTTED SKUNK — *Spilogale putorius*

Other names: Civet cat; weasel skunk.

The spotted skunk just squeezed in under the wire. It is known from less than a dozen individuals trapped in the mountains of Bedford and Fulton counties within 6 miles of the southern border.

Half the size of the common skunk but twice as agile, this striking little carnivore is a born mouser. It can as easily climb a tree to raid a tempting bird nest as it can nose rats out of a corncrib.

The spotted skunk is about the size of a gray squirrel—about 18 inches in length. Females average 1½ pounds; males 2 pounds in weight.

SPOTTED SKUNKS are only about half the size of the common skunk, but twice as agile. This striking little carnivore is a born mouser. It is both a tree climber and an earth digger.

The black-and-white color scheme is basically the same as that of the striped skunk, but with variations. *Four* white stripes start down the back and shoulders, breaking up on the sides and hips into transverse bars and spots. The overall effect is one of a confused mixture of spots and stripes in contrast to the simpler striping of the common skunk. Its soft fur is not as coarse as that of other skunks.

The spotted skunk is a common southern and western animal. It occurs in dwindling numbers north through Maryland and that part of Pennsylvania drained by the Potomac River. Trappers in that area, on Tussey and Martin mountains, Sidling Hill and Gabriel Knob, have been taking one or two a year for many years. The animal has occurred in that area for at least 40 years, but remains scarce and local. In Pennsylvania they have been most commonly taken in dry, rocky mountain forests but like some skunks, occur in a wide variety of habitats farther south.

Spotted skunks are omnivorous. Their active habits are quite in contrast to those of the slower striped skunk and, small as it is, it is a formidable mouser. Insects form the largest percentage of its diet in season, supplemented by mice, small birds and their eggs, snakes, worms, fruits, frogs, even corn and oats.

Their habits in Pennsylvania are unknown. But they do not hibernate and are believed to be active throughout the year. Although in the south they occasionally make nests even in trees, they are burrowers, and like most skunks, spend the daylight hours underground.

In the southern portions of their range spotted skunks are suspected of having 2 litters a year, but this far north, only one annual litter is produced. Very little is known about the breeding habits of the animal at the northern extremities of its range. Four or 5 pink young, often more, each weighing about ⅓ of an ounce, are born in the spring. In 3 months they have reached their adult weight.

Like all skunks, this one also has an effective defense. The scent glands under the tail are handy in case of emergency. This little skunk has an interesting habit of doing a handstand during its warning display. This probably has the advantage of hoisting its "big guns" up to where they can do the most good. The scent is quite penetrating. Connoisseurs of such things claim that the scent is "keener" with more of a "bite" to it, not as "mellow" as that of the striped skunk.

This animal has the reputation of being especially susceptible to rabies. It can indeed contract rabies, but no quicker than any other animal. Its active habits and normally fearless disposition may make it more susceptible to bites of rabid animals, however.

Is this little furbearer increasing its range in the State today? The evidence is inconclusive, but barring any major climatic change, it will probably remain one of the State's rarest furbearers.

Subspecies in Pennsylvania: Spilogale putorius putorius (Linnaeus).

Range: Mountains of Bedford and Fulton counties.

SKUNK — *Mephitis mephitis*

The sad thing about skunks is that they have never mastered a defense against the automobile. Fortunately, they are a prolific lot, well able to handle themselves in almost any kind of a situation, and have held their own against the inroads of civilization.

Skunks live as happily in the middle of Suburbia as in the country. They may live under a back porch without anyone suspecting it unless they meet the neighbor's dog, say at 2 a. m. under a bedroom window, in which case the entire down-wind neighborhood "scent-ces" its presence.

All the skunk asks is to be left alone. He may waddle his way through life without once resorting to chemical warfare. But the potential is there, and the skunk is well aware of it. It colors his entire personality.

Shy and retiring, the skunk is, nonetheless, absolutely fearless and completely self-confident. Musk is only discharged as a last resort when bluff fails, or when the animal is badly frightened. The bluffing technique is as characteristic as the buzz of a rattlesnake.

THE SKUNK, known for its striking black and white coat and strong defense mechanism, asks only to be left alone. They live as happily in the middle of Suburbia as in the country. They may even live under a porch without being detected until confronted by a curious neighborhood dog . . . then look out!

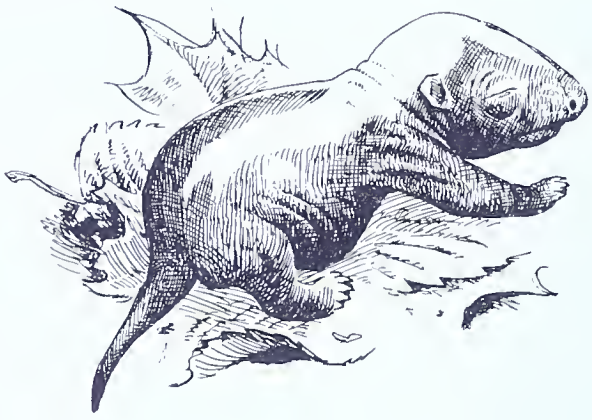
Though a member of the weasel family in good standing, the skunk with its little pig eyes and its flatfooted waddling gait looks more like a tiny bear with a long tail than any of its immediate relations.

Basically a black animal, the skunk has a blaze of white on its forehead and a white mantle across its nape and shoulders that separates into two broad white stripes running back along its sides. The long fly-whisk tail is peppered black-and-white, usually tipped with white. No two skunks are quite alike and the amount of white is extremely variable. This fact is recognized in the fur trade. Pelts with the least amount of white fetch premium prices.

Skunk fur is long, lax, a little on the coarse side, but nonetheless luxurious; the black shining like polished ebony; the white, clean and tidy.

The average skunk weighs about 4½ pounds but large old individuals rolling in early-winter fat can reach twice that weight. Adults average

BLACK AND WHITE PATTERNS SHOW DISTINCTLY ON BARE SKIN OF NEWLY BORN BABY SKUNKS.



2 feet in length including the 9-inch tail. Growth is rapid as in all members of the weasel family. In 2 months' time a baby skunk may weigh as much as 2 pounds. By trapping season in November the young of the year are adult size.

In early February when its arch enemy the great horned owl begins nesting, the skunk gets amorous, prowling the neighborhood with more than food on its mind. The gestation period averages 63 days. The annual litter, 4 to 6 skunks, pink and helpless, arrives in April or May. The young spend the first weeks of their lives deep in the warm security of the burrow but by July are out foraging for themselves—little carbon copies of their mother whom they follow Indian-file through the night woods with all the tenacity of a brood of baby ducks.

Skunks are as omnivorous as bears, with less emphasis on the vegetable end, but great attention paid to small things, especially insects. During the summer months insects make up half the diet—beetles, grasshoppers, crickets, followed by an earthworm or two for "dessert." Fruits and berries are avidly consumed when available and the menu is supplemented now and again by mice, eggs, nestling birds, or a frog or two. Skunks cannot climb trees which limits their "egg hunts" considerably. But they are not often a serious menace even to birds that habitually nest on the ground.

By winter the skunk is well padded with fat. This is its winter larder which it supplements with whatever providence throws its way—dried fruits, grapes, cherries, frozen apples, carrion, mice, or hibernating insects. Skunks occasionally get a sweet tooth and dig out a bumblebee's nest, consuming comb, larvae, bumblebees and all. They are rarely of concern to the honeybee whose hives are usually out of reach. All in all, this is an innocuous little predator. And a burrow of skunks under the hen house is vastly to be desired to a rat warren.

The burrow, within which the skunk spends most of its life may be 10 to 15 feet long, ending in a comfortable little room crammed with perhaps a bushel of dried grasses and leaves. Often an old woodchuck or a fox den is remodeled to suit the skunk's taste. Burrows under buildings are relatively easy to construct and may have multiple exits. Burrows are often dug under rocky overhangs and invariably in well-drained sites above any danger of wet feet. Skunks prefer to do as little excavating as possible, and if a ready made den suitable for remodeling is not available, they will often set up housekeeping in a brush pile, hollow log, or abandoned outbuildings.

Autumn may bring about "spring housecleaning" as fresh bedding is added to the den. The skunk, now fat and lazy, prepares for winter. Some of these hibernating dens become regular community affairs. Curiously enough, these denning concentrations, perhaps presided over by a single male, are composed almost entirely of females. As many as 18 females have been taken from a single winter den but half a dozen or so is more common. The males, except for brief periods of severe weather, are usually active all winter and their characteristic footprints are often seen in the snow. Hibernation is not the comatose near-death of the woodchuck, the jumping mouse, or the cave bat. The skunk, like the bear, just dozes off for a few weeks, living on the slow fuel of its fat reserves.

Some skunks stay active through even the coldest days of winter and make nightly rounds. For all of their nocturnal wanderings though, skunks are essentially stay-at-homes. Established individuals rarely wander farther than a half-mile from their burrows.

Their enemies are relatively few. A hungry fox or a bobcat may take one now and then. The great horned owl, who mercifully lacks a sense of smell, occasionally indulges. But more often than not, skunks are highly-respected and much-avoided little animals.

Abundant food and cover, relative immunity from predation, and a high breeding potential enables skunks to reach high population levels at times. These skunk "highs" are soon cut down by disease. "Lows," during which the animals are almost wiped out over large areas, alter-

nate with the highs over the years. The diseases which periodically decimate their numbers have not been adequately studied. Rabies may reach epidemic proportions in skunks, but other diseases are believed to be more important.

The skunk is one of the more important of the furbearers in terms of pelts sold on the fur market. In some years (1946-47 for instance) close to 100,000 skunks were trapped in Pennsylvania. During 1961-62, however, skunks ranked fifth among Pennsylvania furbearers; only 2,746 pelts were marketed. Trapping has little effect upon the population as a whole. Although 100,000 skunks sounds like a good many animals, such a harvest apparently leaves the breeding potential unimpaired.

Many are the recipes for dispatching a trapped skunk without getting "skunked." None are infallible and few of them work. The scent glands, highly developed in the weasel family, are two muscular glands located beneath the skin under the tail. Each has a short tubular outlet which can be protruded through the anus in times of stress. The scent, which smells like a combination of steel mill, rotten egg, and the tiger house at the zoo, is as penetrating as ammonia. This liquid contains butyl mercaptan, an organic sulphur dioxide compound in a highly volatile oil base. The skunk directs its spray by lining up its hindquarters and fires with devastating accuracy by constricting the sphincter muscles that surround each scent gland. It has been known to hit a target at distances of 10 to 15 feet. The scent will not cause permanent harm to the skin or the eyes, although it will sting unmercifully for a short time. It has phenomenal lasting qualities but fortunately in dilute form, is not at all bad smelling. Detergent soap and water with lots of Chlorox and elbow grease will help to remove it.

Skunks are found throughout the State. Most common in cultivated areas and forest-edge situations, they are rarest in the dense mountain forests. But there always seem to be a few available to clean up the crumbs of a roadside picnic just about anywhere.

Subspecies in Pennsylvania: Mephitis mephitis nigra (Peale and Palisot de Beauvois).

Range: Throughout the State.

RIVER OTTER *Lutra canadensis*

Other names: Land otter; otter.

Sleek as an otter, playful as an otter, graceful as an otter, smart as an otter—he's earned them all. This large-sized, aquatic weasel is one of the most delightful of mammals.

Otter bones are common finds during the excavation of prehistoric Indian village sites anywhere in the State. The otter was one of the most widespread fur bearers on the continent and, along with the beaver, was eagerly sought by the early fur trappers for its stunning pelt.

The otter has been accorded complete protection in the State since 1952 but has found it hard going. A victim of polluted streams, deforestation, relentless trapping and undeserved prejudice, it is rare in Penn's Woods today. A few survive in the Pocono Mountains of northeastern Pennsylvania, but throughout the rest of the State they are extinct. The last recorded otter in the Allegheny River was shot in 1899; in Pymatuning Swamp in 1908.

The otter is about the size of a fox but built like a weasel with dachshund-type legs and a beady-eyed expression. They are solidly built and may weigh up to 20 pounds, almost twice that of the fox. The heavy tail, almost a foot and a half in length, is not long-furred like a mink but covered with hair as short as those in the remainder of the pelt. The toes, as befitting an aquatic animal, are webbed. The fur is soft and dense, perfect insulation through the coldest spells of winter. It is a rich brown color, lighter on the underparts.

The otter is, above all, a fish-eater, but a non-selective one. It is perfectly capable of catching a trout, so adept a swimmer is it, but studies indicate that, although fish rank first in the otter's diet, more than half of the fish consumed are minnows and suckers. In streams or lakes where the game fish are stunted due to over-population, the otter may serve a useful function, as anyone who has ever weeded a garden or thinned out a crop of carrots can appreciate. Their indirect effect upon fish populations by consuming other fish predators has never been assessed. Fish are exposed to predation at all stages of their life cycle and the otter's diet includes a good many potential egg and fry eaters, crayfish, predatory insect larvae, hellbenders, turtles, water snakes, etc. They are capable of wreaking havoc at a fish hatchery, but in natural waters, open streams and lakes, the otter is not the villain it has been painted. There appears to be no relationship between muskrat and beaver populations and the presence or absence of otter.

A member of the weasel family, the otter, like its larger cousin, the fabulous sea otter, has turned its back upon the land. It is as adept at swimming as is any seal. The long, sinewy body which must be tortured into awkward caterpillar contortions on land, lends the agility of an eel to the animal in the water. It can travel over a quarter of a mile before

surfacing, and is adept at diving and foraging along the bottom for its prey. An otter, like a beaver, exposes only its head above the surface of the water. But, unlike the beaver, the otter has a great deal of curiosity and may behave like a miniature seal, head erect and alert, gazing intently about. Upon surfacing they may blow and puff like any seal, but ordinarily are silent animals, unless they are playing among themselves when they may utter a variety of rather subdued chirps, growls, and other strange sounds. The distress call of an otter is reputed to be a real hair-raiser, capable of carrying a mile and a half.

OTTERS have been afforded complete protection in Pennsylvania since 1952, but have faund it hard going. A victim of polluted streams, defarestatian, relentless trapping and undeserved prejudice, it is rare in Penn's Woods today.

Alert, active, and highly intelligent, otters are ever on the go, except during the breeding season. They hunt for a living and range along stream courses for miles. Their tracks may be seen at all seasons of the year. During the winter otter must seek open water, and the broad furrow-like paths along the bank, as they plow their short-legged way through deep snow, may be very prominent. In suitable flat areas and on ice an otter track is unmistakable. Like a kid on a pond, the animal runs a few steps and throws itself headlong on the ice belly first and slides 3 or 4 yards, only to pick itself up and slide again.

They seem to enjoy sliding so much that they may keep at it all year around, zooming down snow banks in the winter, and stream banks in the summer. Like children at the play slide in the park, they climb up over and over again for "just one more turn."

In the "facts of life" department, knowledge of the otter's breeding habits are not well known. Most of what is known is based upon ob-

servations of a few captive animals. Estimates of the gestation period may vary from 9½ to 12½ months. This would imply delayed implantation—the fertilized egg developing to the early embryonic stage, then lying dormant for many months before resuming development in early spring. Delayed implantation is found in many, but not all, members of the weasel family. It may not even be found in all otters. The European otter, *Lutra lutra*, closely related to the American otter, has a gestation period of only 63 days.

Young, usually 3 to 4, are born in early spring. They are as helpless as new-born kittens. Their eyes open at about the 35th day but it is another two weeks before they meet the world. Like the young of those other master aquanauts, the seals, baby otters are reluctant to enter the water. They have to be coaxed, occasionally even tossed in bodily. But it doesn't take long before they are making short cruises on their own.

Home is usually an underground burrow, often extensive. Although it is most often located along a stream bank and may even have an underwater entrance, some dens have been found as far as a half-mile from the nearest water. If suitable soils for digging burrows are not available, the otter will have its young in hollow trees, nests of brush in dense thickets, under protecting tree roots or in abandoned beaver lodges.

This is an animal that probably can be brought back to Penn's Woods. Leaving aside the value of its magnificent pelt, who would not be pleased to find a 30-foot otter slide along some woodland bank or to have an alert head pop up and give him the once-over off the starboard bow? The otter is not incompatible with civilization as such, and with intelligent management, it may yet regain its proper place as our most desired fur bearer.

Subspecies in Pennsylvania: Lutra canadensis canadensis (Schreber).

Range: Throughout the State except the southeastern corner.

Lutra canadensis lataxima F. Cuvier.

Range: May possibly enter the southeastern corner of the State.

WILD CAT *Lynx rufus*

Other names: Eastern bay lynx; bobcat.

The wild cat is many things to many people. Some children, fed on tales handed down from pioneer ancestors, shudder at the very mention of the name, and imagine, embodied in this creature, all the ferocity and terror of the wild. The visitor to the zoo frequently gets a similar impression, for crouching in the very back of the cage will be glimpsed a huddled ball of fur, teeth gleaming white as the owner snarls and hisses its frustration with the world. Then there are the trappers, more concerned with the pelt than the temperament, who find the wild cat easy enough to kill with a club and relatively unaggressive, in spite of their fearsome appearance. And there are the small game sportsmen and hunters who consider it an unmitigated pest and predator, and a strong competitor for the very game that they seek.

So, too, there are the clinical-minded biologists, weighing the facts on the balance of nature, and recognizing the need for both prey and predator. Finally, there is the citizen born with the love of everything wild and thrilling at the mere glimpse of a bobcat engaged in its normal pursuits.

What, then, is this animal which has the power to arouse such mixed emotions and cause so much controversy? Actually it is only an outsized, long-legged cat, with an abbreviated tail. Its summer coat is predominantly brown, with black and gray hairs scattered throughout; the belly fur is much lighter and spotted with black. The winter coat is considerably longer, much more dense and somewhat lighter in general tone, although it never acquires the pearly-gray overtones of the Canada lynx, which it closely resembles. Nor does the bobcat acquire the very long, black ear tufts of the lynx, nor the enormously padded paws.

In the summer, however, it is very difficult to tell a bobcat from a Canada lynx, particularly if the tail has been removed from the pelt. The tail is the one definite source of identification, if skulls are not available for comparison. The Canada lynx's tail-tip is ringed with a black-brown band; the bobcat has a black mark at the tip of the tail, but it does not encircle it. The two animals cannot be distinguished by size or weight, although the lynx appears to be the larger of the two, especially in its full winter coat.

There will be little reason for confusion in Pennsylvania, however, for the Canada lynx does not occur in the State. The lynx prefers the unbroken coniferous forests and the solitude of the north country, and rarely ventures this far south. The bobcat, on the other hand, is a denizen of more southern zones, preferring broken forests, open glades and rock ledges.

The bobcat is not a large animal, for it averages only 36 inches in total length, with the 7 inch tail included in that measurement. Weights of adult animals have varied from 15 to 44 pounds, but a good average would be 15 to 20 pounds.

In late February or early March, the male may cover 20 miles in a single night searching for a female bobcat. After a gestation period of approximately 50 to 60 days, 2 to 4 young are born in April or early May. They are blind and helpless, but well-furred and spotted. After about 9 days, the eyes open, and within 2 months the young are weaned, although they stay with the mother for a period of several more months, completing their training period and formal education. The home den may be in a rock ledge, old stump, or large hollow tree, and it is always cosily lined with dry leaves and moss.

The bobcat is primarily a nocturnal animal, although it is occasionally seen abroad during the daytime. Its large eyes are well-adapted for seeing in the darkness. Wild cats rely principally on their eyes and ears, rather than their snub-noses, for hunting. Meat is their favorite food, and that is the source of their evil reputation. Snowshoe rabbits, for instance, are caviar to them. In addition, cottontail rabbits, grouse, turkeys, small birds and eggs, rodents, fish, frogs, and occasionally, fox and deer, are all grist to their dietary mill. Their hunting technique is based on stealth and they rarely pursue their prey. Rather, the wild cat goes to a game trail or seeks a vantage point where, with all the stealth of a well-seasoned bandit, it hides at a likely spot. When the unsuspecting victim reaches just the right point, the bobcat leaps, claws outstretched and teeth at the ready, and the meal is on the table.

Or, the cat may stalk its prey in typical "Jack the Ripper" fashion, pouncing with deadly skill when the range is right. When the deed is done, and the bobcat's appetite appeased, there will be no more killing in that vicinity for awhile. Someone once remarked that the bobcat is a good conservationist. It doesn't decimate a population. Rather, it kills here today and there tomorrow, never lingering long enough to eliminate its food supply. This is true of most predatory mammals.

The bobcat's calls are simply those of a house cat magnified. It mews, yowls, caterwauls, howls, growls and hisses. In captivity it has been heard to purr, and probably does the same in the wild. It expresses pleasure in throaty, dulcet tones, and whether these are purrs or mews it is difficult to say.

When the Commonwealth of Pennsylvania was in its infancy, the wild cat was abundant over the entire State. At present, this lone representative of native wild cats is scarce and is confined to isolated sections of the more remote mountains. Because of its wandering habit, however, there are occasional records of its appearance in almost any of the mountainous counties. Bounties were paid almost constantly on bobcats from 1810 until the $15 payment was removed in 1938. During

the 8 years prior to that time, 97 to 211 bobcats per year were submitted for bounty. The peak year for claims was during the fiscal year 1915-1916 when 862 cats were killed. Now, although there is no longer a bounty paid on them, the wild cat has not been given protection and a certain number are killed for sport or through trapping each year. Today, there may be less than 100 bobcats in the State, with an annual kill by hunters and trappers of 15 to 30.

Friend or foe, terrible predator, thrilling subject of the chase, or just plain member of our wildlife, it would be a shame to permit this unique cat to vanish with the wolf and panther. Under the conditions now existing, it is highly unlikely that a dangerously large population could build up even if this cat were fully protected.

Subspecies in Pennsylvania: *Lynx rufus rufus* (Schreber).

Range: Throughout the State.

WAPITI — *Cervus canadensis*

Other names: American elk; American stag.

The American elk, or wapiti, was originally native to the vast reaches of forest land across Pennsylvania, and the species ranged over most of the United States and southern Canada. The greatest concentration in Pennsylvania seemed to be in the mountainous central portions and the Pocono region of the northeast. During severe winters, the herds were sometimes forced down into the lower reaches of the Allegheny, Susquehanna, and Delaware river valleys. Pennsylvania's elk apparently reached a greater size than those in most other parts of the range, and some tremendous trophy sets of elk antlers still exist in mute testimony to these former monarchs of the forest.

Although extremely abundant at the time of the first settlements, by 1750 the elk were already showing the effects of persecution. Like so many other big game animals, they were slaughtered by the thousands without thought of the future. Many were slain merely for the hide and the souvenir "tooth."

By 1800, the wapiti was no longer to be found in southeastern Pennsylvania. It was a rare sight in the Cumberland and Blue Ridge areas of southcentral Pennsylvania and west of the Allegheny River. However, the Poconos and the Allegheny Mountain and Allegheny Plateau regions were still well stocked. But by 1830, the elk were gone in the southwestern corner, and between 1835 and 1845 they disappeared from the Pocono region in the northeastern part of the State.

The last real stronghold for the elk was the section lying between the headwaters of Bennett's Branch of the Susquehanna and the Clarion River to the west and north. Elk County, established in 1843, received its name from the presence of this last native herd. During the winter of 1852, a herd of twelve yarded along the Clarion near the present site of Ridgway. Two Indian trappers killed seven of these animals,

ELK AND DEER are members of the same family, but they certainly are not nearly the same in size. Here District Game Protector Norman Ericksan of Cameron County and his son examine illegal kills of each.

and that apparently was the last time that a band of native elk ever yarded in Pennsylvania.

Along the headwaters of the Clarion, the wapiti made its last stand. There, in November 1867, Jim Jacobs, a full-blooded Indian, killed the

last Pennsylvania elk. Extermination of a magnificent game animal was complete. It took early Pennsylvanians less than 200 years to extirpate the buffalo herds, the stately elk which the natives had long used for food, the eastern mountain lion, king of North American cats, and even the wolves which howled at the settlers' doors. The great and powerful Commonwealth of Pennsylvania was carved from the wilderness, and sacrificed on the altar of progress were the wildlife, the mighty timber and the purity of the rolling waters. Fortunes were made and lost, but the strain of conquering a wilderness was over, and industrialization brought shorter working hours to the laboring man. With leisure came time for meditation and recreation.

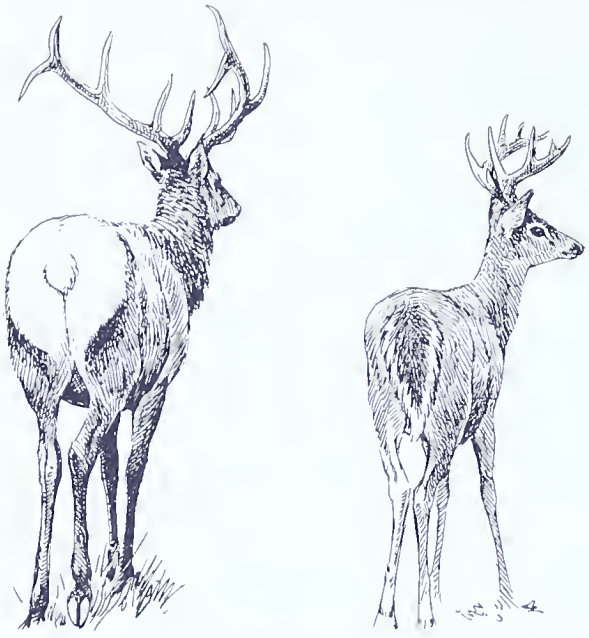
By 1910 enlightened Pennsylvanians were looking, with horror, at the destruction which had been wrought. Less enlightened, but just as enthusiastic, hunters and fishermen were bewailing the loss of sport. What was to be done? Even the seemingly boundless herds of deer were decimated, and no self-respecting fish could hope to exist in the stench of polluted rivers and streams. Out of this chaos, and through the unswerving efforts of a few dedicated and far-seeing men, was born the theory of conservation of Pennsylvania's wilderness and wildlife. What was left was to be encouraged and protected. What had vanished might be replaced from stock left in other parts of the country.

Coincidental with the desire to restore Pennsylvania's lost wildlife, a crisis arose among the enormous elk herds which thronged Jackson Hole, Wyoming. During the winters of 1909-1910 and 1910-1911, terrific losses were caused by starvation, and the Federal Government, in an effort to alleviate the situation, decided to dispose of some of the live animals. The winter of 1911-1912 was the beginning of all shipping and restocking with elk taken from Yellowstone Park.

Pennsylvania made its first releases in 1913 when 50 head from Yellowstone and 22 from a private preserve in Monroe County were shipped to the north-central part of the State. The western elk were divided equally between Clearfield County and Clinton County. Twelve of the Monroe County animals were released in Monroe County itself and 10 were sent to Centre County. At least 14 of the Yellowstone elk died shortly after arrival and a portion of the survivors wandered as much as 40 miles within a week. Those from the private preserve moved 20 miles or more in the first few days.

Although no more elk were purchased in 1914, a number of calves were reported seen during that summer. Also, some crop damage complaints were received. At least 5 were shot illegally during the year.

In 1915, a total of 95 elk were obtained from Yellowstone and stocked in Potter County (24), Cameron County (24), Carbon County (24), Forest County (10), Blair County (7) and Monroe County (6). With this boost, they began to increase and a herd of 25 to 30 appeared in Blair County some distance from the nearest release site. Property



ELK ARE KILLED illegolly in Pennsylvania in mistoke for deer. In addition to the great difference in size, the rump potch is the obvious field mork on the elk. The deer only shows white when alarmed and then the tail is raised os o white flag.

damage complaints also increased and a number were killed to protect crops each year.

Elk had become sufficiently abundant by 1923 for the Game Commission to establish an open season (December 1-15). Only bulls with 4 or more points to one antler were legal. The open seasons became an annual affair from 1923 to 1931, but these magnificent big game animals have been given complete protection in Penn's Woods since that time. During the first season, 23 legal bulls were taken; the next year the take dropped to 10; and by 1925 the number had dropped to 6. The final season in 1931 saw only 1 elk shot legally. Altogether 177 were released and 176 were recorded killed in season, illegally or for crop damage.

The elk is one of the largest members of the deer family, second only to the moose in weight, and measures approximately 80 to 100 inches in total length, with the tail measuring only 4 or 5 inches. At the shoulder, the animal is close to 60 inches high. The adult male may weigh as much as 1,000 pounds, but a better average would be from 600 to 700 pounds, with the adult female smaller and something over 100 pounds less in weight.

Although there is a great deal of color variation, the characteristic color is brown, varying from grayish on the sides to very dark sometimes almost black, on the neck and legs. In winter there is a woolly undercoat, largely concealed by the guardhairs, and this tends to make the coat appear dark brown. The rump patch is tawny-white, bordered on the sides with a black line that fades toward the dorsal line. The summer coat, acquired from early April through July, is short, stiff and close to the skin, with little or no underfur. The elk, in full summer coat, takes on a glossy, reddish appearance, and appears trim and muscular.

September is the height of the rutting season. The gestation period is approximately 8½ months, and the young appear by the end of May or the first of June. One calf is the rule, but occasionally there are twins and once in a great while, triplets. The calves are precocious, and can follow the cow two days after birth. They begin to feed on vegetation when less than a month old, but they continue to suckle throughout the summer.

Elk are not as restricted in their diet as are white-tailed deer. They are more of a grazer than deer, and the so-called elk grass and brake are their favorite foods. They can subsist on buds and branches when necessary. Almost all deciduous trees appeal to them. They prefer to feed before sunrise and shortly after sunset, although at some times of the year they may be seen feeding at almost any time during the day. In hot weather, however, they like to lie down in midday and laze a few hours away.

It is the custom of elk to "yard up" in heavy snow, or when the weather is extremely cold, and this gregarious habit, and refusal to move out when the food supply is gone, often results in tragic losses.

The sound most commonly associated with the wapiti, is, of course, the bugling, difficult to describe but once heard, never forgotten. It is usually associated with bulls during the rutting season, but careful observers report that it may be heard almost any time, and frequently a cow will be doing the bugling! Calves, when young, do a good bit of squealing, and the cows habitually indulge in short, sharp barking. This barking would appear to be a signal to the calves, or at other times, simply a snort of surprise.

The reintroduction of elk to Pennsylvania has not been a signal success. Although they were placed in what appeared to be ideal surroundings and under ideal conditions, the present herd numbers only 50 to 100 animals and is restricted to Cameron and Elk counties. Most observers believe it is barely holding its own.

The crop of calves has been disappointing in recent years and there is no indication that the situation will improve. Many reasons have been advanced for the failure of the herd to increase after 1931, and it might not be out of place to examine a few of these theories.

At first the brush forest and mountain farms offered near-ideal food and escape cover, with very little human interference. Soon, however, the brush forest was replaced by larger trees and, as the brush vanished, an easy source of food disappeared. At the same time, modern farming and better transportation opened up the country and the farmers became less tolerant of the depredations on their crops. More elk were killed because of crop damage or by just plain poaching.

The competition of an ever-growing deer herd has also been considered of importance, but there are some who question this theory on the

basis that the elk, being a large animal, can take advantage of browse beyond the reach of the smaller deer. What is more, they say, the elk is more dependent on grasses than the deer.

Another factor may be the intolerance of elk to civilization. It is true that elk thrive in Yellowstone Park, apparently undisturbed by the proximity of hordes of tourists. However, the Park is a tremendous area and the animals are rigidly protected and have more than adequate room in which to move if they are bothered. It is a well-known fact that animals recognize protected areas and adjust themselves accordingly. But elk are thought to be "high strung," and in restricted areas disturbance and lack of solitude may result in low reproductive rate.

Whatever the contributing causes may be, there is no doubt that man himself, is one of the most potent factors in the failure of the herd. Destruction for crop damage, poaching, and last, but not least, illegal killing in the deer season, has eliminated and even exceeded the annual increase. There is no excuse for an elk being shot mistakenly for a deer. A white-tail deer could easily walk under an elk without having to stoop! It is not the true sportsman or hunter who does the damage, for he knows the game he seeks, and never shoots something "by mistake." The blame must lie at the door of the game hog, the neophyte, the victim of "buck fever," or those with the lust to kill. There is a penalty of $200 for an illegal kill, and, at the Court's discretion, six months in jail.

Subspecies in Pennsylvania: Cervus canadensis canadensis Erxleben (now extinct).

Replaced by *Cervus canadensis nelsoni* V. Bailey

Range: Restricted to a small area in the northwestern part of the State.

WHITE-TAILED DEER — *Odocoileus virginianus*

Common names: Whitetail; Virginia deer; banner tail.

The white-tailed deer is a symbol of Pennsylvania's wilderness heritage. It sustained the early trapper and tided the pioneer over the first difficult years, just as it had supported the Indians of Penn's Woods for countless thousands of years before that. Although hounded almost to extinction by the turn of the century, the whitetail is, nevertheless, very much with us today.

In the Keystone State, the deer has become a precious crop, its numbers controlled by annual harvests, varying land practices and forestry programs. The deer has also become big business. Since 1915, about 2½ million of these animals have been harvested by hunters according

to Pennsylvania Game Commission figures. Translated into sales of ammunition and firearms, food and lodging, gasoline and oil, this harvest provides an annual multi-million dollar shot-in-the-arm for rural communities throughout the State.

Although the white-tailed deer is now the "official" Pennsylvania State mammal, it ranges from coast-to-coast and from central Canada to northern South America. However throughout much of the West, it is replaced by the larger mule deer and black-tailed deer. The white-tail is confined to the New World and apparently always has been. This is not true of the elk which belongs to a subfamily of Old World deer. It is a relative newcomer to the Western Hemisphere, having arrived in the last Ice Age.

The white-tailed deer is a large animal. It stands about 3 feet high at the rump and shoulder and is about 5 to 6 feet in length. Depending upon age, sex, time of year and physical condition, "adult" deer may weigh from 50 to 350 pounds. The average Pennsylvania white-tail buck will weigh in at about 100 pounds hog-dressed; the average doe at about 70 pounds. However, dressed weights of 150 pounds for bucks and 100 pounds for does are not uncommon. A hog-dressed deer—the carcass minus all viscera—is 25 to 30 percent lighter than the same animal on the hoof. This can vary enormously with the general condition of the animal and hog-dressed weights may be deceptive.

Deer in their summer coats are reddish-tan with white underparts. The neck is tan throughout but for a white "bib." The characteristic tail is white beneath, tan and black above, fringed with white. The winter pelage is identical in pattern but much deeper in tone—a grizzled gray-brown to a deep blue-gray.

Hair of the deer family, including elk, moose and caribou, is unique. Individual hairs are coarse, brittle and crenulated, with a narrow root and a relatively large shaft. Under magnification they are "hollow" and each hair is filled with trapped air spaces, providing the deer with such

FAWNS ARE BORN in Pennsylvania in late May and early June. The crop of the year usually increases the herd by 20-30 percent, creating a surplus which must be harvested in order to keep the herd in balance with available food.

perfect insulation that it can bed down for the night in the snow without melting it.

Despite their large size, deer have a relatively small home range. An individual may spend its life within the confines of a few square miles. Deer appear reluctant to leave "home" and, even when hard pressed, will circle about in its boundaries. Secretive and nocturnal, deer readily infiltrate farming country with its woodlot—open field pattern of land use. The largest racks and the fattest deer in Pennsylvania are usually "farm bred."

Conspicuous skin glands are found in deer. The tarsal gland lies on the inside of each hindleg at the hock joint and is covered by a tuft of long coarse hair that is capable of being erected. These serve as a means of scent communications. The metatarsal gland lies on the outside of the hind leg halfway between the hoof and the hock. They are about 1¼ inches long by ¼ inch wide. They are probably scent-producing glands, also. The interdigital glands are located deep between the toes of each foot. They have a pronounced odor. Their function is undoubtedly production of scent to permit one deer to follow the trail of another. These glands are present on all deer, regardless of sex or age, but their uses and associations have yet to be learned. There is a small gland in front of the eyes. This does not appear to be as well developed in deer as in some other hoofed animals. Its function is not known.

Deer are extremely prolific animals. They are adaptable to either farm or forest conditions wherever food is available. Pennsylvania's present herd, about 500,000 to 600,000 animals, is regulated somewhat by the carrying capacity of the range. The annual turnover due to hunting (about 125,000 to 175,000), automobiles (10,000 to 15,000), dogs, starvation and poaching may seem high in the aggregate, but these are balanced by the annual fawn crop. A substantial increase in the size of this herd would result in high numbers of stunted and winter-killed deer. White-tails if unmanaged will literally eat themselves out of house and home.

This deer is a semi-solitary animal which travels in small bands believed to be composed of loose family groups. They tend to congregate during the winter months at food sources, particularly in valleys between the mountains, but individuals or small groups come and go and there is no pronounced "herd instinct."

BUCK RUBS are made by male deer stripping off the velvet from their newly developed antlers. This is the beginning of the rut or breeding season.

There is a tendency for bucks to dominate small groups of does during the rutting season. This lasts from about late October to late November. Females come into heat for about 24 hours. If fertilization does not occur at that time, she will come into heat 3 or perhaps 4 times at monthly intervals. It is therefore possible for a doe to be bred in midwinter. The majority of late matings are female fawns, 7 or 8 months of age which were sexually immature during the normal rut. The gestation period is about 205 days. Since most of the does were serviced during a short period in the fall, most fawns are born about the last of May and the first of June.

It is not uncommon in areas of good food for a doe to produce her first fawn at the age of one year. A doe may bear a single fawn, twins, triplets or rarely quadruplets. The first offspring will usually, but not always, be a single fawn; after this, at yearly intervals, twins are the rule. Does have been known to breed annually for as many as 15 years. There is one record of a Wisconsin matriarch who survived for 19½ years and whose last fawn was born to her in her 18th year. However, in the wild, a white-tailed deer is lucky indeed if it reaches the age of 4 to 5. The overall Pennsylvania average, including all adult does, is 1.7 fawns per year. The fawn crop each year increases the herd by 20-30 percent, a surplus which must be harvested to hold Pennsylvania's deer herd at its healthiest level.

Fawns weigh about 5 to 6 pounds at birth. Like the young of all hoofed animals, they are born in an advanced state of development, fully haired, eyes open, a little gawky and unco-ordinated, but still one of the most endearing of all wildlife babies. For the first few days of their existence they remain curled up in the underbrush. Their spotted coats lend camouflage; they seemingly cast no scent; and, unless they betray themselves by movement, they are relatively safe from predation. The doe, never too far off, returns at intervals to feed her offspring which, with tails twirling with excitement, butt and tug at her udder like little calves. Fawns grow rapidly in strength and stature and by late fall are half as large as their elders. Buck fawns by then may weigh 60 to 70 pounds on good range. Their spotted coat is shed and they enter their first winter indistinguishable in color from adults.

Antler growth begins the following spring and continues throughout the summer months. The antlers at this time are in "velvet," covered with live skin and richly supplied with blood vessels. These developing antlers are warm to the touch and appear fuzzy with a short coat of hair. When the antlers are developing they are quite sensitive and may bleed profusely if injured. Bucks are as cautious at this period as a matron with a new hairdo.

The initial growth of the antlers is believed to be controlled by a hormone secreted by the pituitary gland which is in turn influenced by the increasing hours of daylight in the spring. During late summer or early fall when antler growth has been completed, a change comes over the buck as it approaches the rutting season. The male hormone testosterone, released by the testes, begins to transform the buck. The "velvet" dies and strips off from the antlers which are by now dense, hard bony weapons. The neck muscles swell as the buck prepares for battle. Bucks who ignored one another all summer erupt into fights as they spar and push with clashing antlers for possession of the does. After all of the fury has died down and the loser vacates, there is rarely any lasting damage done on either side. Occasionally two bucks sparring with lowered heads will mesh antlers in such a fashion that they interlock and both animals die a lingering death.

After rutting season, the level of testosterone in the buck's system drops lower and lower. A narrow zone of bone beneath the coronet of each antler is absorbed and the antlers loosen at this point, usually within a day or so of one another. The buck remains antlerless until a new set begins to develop in the spring. Antlers may be shed as early as November or as late as May depending upon the health and general condition of the buck.

The age of a deer can be estimated by its teeth but not by antler development. It is true that, in any one individual, successive racks usually get larger and heavier up to 7 or 8 years of age. But individual variation is so great and development so influenced by the general health of the animal, that antlers are generally useless for assessing exact age. There is a trend towards a greater number of points with advancing age but no reliance can be placed upon it. It is not unusual for an 8-point yearling to be bagged. And the other side of the coin, spike bucks as old as 4½ years are occasionally taken.

White-tail antlers have become treasured mementos of happy days afield. A finely balanced rack is indeed a thing of beauty even though the less reverent may look upon it as a hatrack. Antler size varies widely from place to place depending upon the state of the range and the general health of the animals. Six, 8 and 10 pointers are commonest. A rack of 11 points is unusual (1 in 20-70), 13 points (1 in 300-400), 15 points (1 in 1,300) and a buck with 17 or more points is a 5,000 to 1 shot.

The white-tailed deer is a browser. During the warmer months of the year vegetation is plentiful and the animal is often quite literally "in clover." Deer require from 2 to 7 pounds of vegetation per hundredweight daily if they are to remain in good health. In winter, they show a decided preference for buds, tender twigs, leaves of trees and woody shrubs. A checklist of woody plant species eaten by deer would run well over 100. Among the evergreens, yew, hemlock and white cedar are most palatable; pines run second-best while spruces and tamaracks form starvation fare. Among broad-leaved trees and shrubs, mountain ash, maples and dogwoods are high on the list, followed by willows, cherries, poplars and oaks. Those plants known to be avoided except as a last resort are ironwood, slippery elm, box elder, witch hazel, ninebark, and at least some alders. Rhododendron and mountain laurel are eaten in times of stress.

In addition to browse, such items as weeds and vines, grasses, clovers, flowers of many kinds and farm crops are consumed in season. Domestic and wild fruits and nuts are especially attractive to deer. They are particularly fond of apples.

Deer always have a surplus of food during summer and early fall, but in the winter, things may be different. When snow lies deep on the ground for days or weeks at a time, deer can become hard pressed. This is the critical time of year. Deer subsist mainly at this season on browse

CONSPICUOUS SKIN GLANDS are found on deer legs and feet. These serve as a means of scent communication. They have a pronounced odor and are present in both sexes. However, aside from the fact that they are used to allow deer to follow other deer, their uses and associations have yet to be learned.

—woody growth, twigs and buds formed over the previous summer. During the winter, if the deer population is too large or too concentrated, all browse low enough for a deer to reach is consumed and starvation sets in. By looking through an overbrowsed woods, a definite "browse line" about 5 feet off the ground can be seen. The majority of animals that die of starvation are fawns because these small deer just cannot reach the food.

Farther north, where snows are deeper and longer lasting, deer will yard up. The herds congregate in small areas which they keep trampled and most of their activities will be confined to these "yards." Fortunately in this latitude winters are more open and "yarding," which may cause severe winter mortality through intense local overbrowsing, does not occur. Even under the best of conditions, February and March mark the low point in the white-tail's year. Weights are at their lowest. Lean and hungry they eagerly await the spring.

Deer apparently are sensitive and selective feeders, picking out a "balanced" diet when they have a choice. In one Centre County wheat field, deer were seen passing through the wheat around the margin to graze on blades of grain which grew on a slight rise in the center of the field. Samples from both areas were analyzed. The wheat that had been deliberately sought by the deer proved to be 1/3 higher in calcium and phosphorous content.

Deer, like cattle, need minerals other than those furnished by vegetation. They are attracted to salt blocks set out for cattle and a favorite,

but now illegal, trick was to bait them by setting up artificial salt licks. This only worked in the spring and summer, however.

Natural "licks" were conspicuous to the pioneer hunter, because the mineral-bearing earth was often bare and churned over several acres. Such sites grew up into weed trees, often hawthorn, to become known locally as "thorn bottoms." A few Pennsylvania place names—Slate Lick, Lick Island, and Deer Lick—still survive to perpetuate long vanished licks. Soils and clays sought by deer have been analyzed, but the results vary widely and it is not often clear just what minerals are the attraction in any one particular case.

Deer, like people, can become stunted in early life if they have poor food. In areas where the population density does not overtax the vegetation and deer get adequate year-round nourishment, they will be large healthy animals and antlers will be large. But let the population explode, and starvation, disease and malnutrition will quickly leave the animals weak and stunted. Lack of proper nutrition will result in a greatly reduced fawn crop, too.

Occasionally, doe deer sporting legal-sized antlers are taken. Six to 12 are shot annually in the State, which is a ratio of about 1 in every 4,000. When this occurs, it is believed due to a hormone imbalance, like the well-known bearded lady, and is a freak condition. Other rarities are the albino and piebald deer. Another oddity is the hereditary defect sometimes called "parrot jaw" which has been noted in Pennsylvania deer. The normal gap (the diastema) between the lower incisors and the cheek teeth is foreshortened giving the animal a chinless, "Andy Gump" look. This appears to have little effect upon the ability of the deer to browse.

In common with all living things, deer are plagued by a variety of diseases and parasites. Naked warty skin tumors (papilloma and fibroma) caused by a virus are common. They are non-malignant, will not affect the meat and are not dangerous to man. Swelling sometimes to softball size, these tumors may cause the animal to decline physically, especially if they interfere with a vital function such as feeding. But they are not fatal in themselves.

Parasites are plentiful and if the deer is in poor condition may contribute to its death. Coccidiosis caused by a protozoan causes severe lesions in the liver and intestines and may be fatal. Roundworms of several species may be present in the digestive tract. Tapeworms, some as long as 10 feet, have been recorded. The immature form of one such tapeworm *(Taenia)* is known as the bladder worm and may occur as a pea-sized watery bladder imbedded in the liver or scattered in numbers throughout the body cavity. They will not mature in the deer but are patiently waiting for another animal to eat the deer before completing their life cycle in their new host. Lungworms, small whitish round worms, may infest the trachea and lungs. The liver may be attacked by

liver flukes—soft-bodied flatworms which may reach 3 inches in length and 1 inch in width. Infected livers have yellowish-white spots or cysts about the size of a quarter just beneath the surface.

Botflies, whose grubs may live in the nasal passages or under the skin, deer ticks, mites and lice (happily host-specific which means they turn up their noses at people) are known to infest deer. A fungus infection of the jaw—actinomysosis or lumpy jaw—is common in captive deer receiving improper food but it is rare in the wild.

This catalogue of parasites and diseases seems quite alarming but the deer is no more parasitized than most animals, wild or domestic, and a good deal less than many. None of these ailments affect the meat. All in all, the Pennsylvania white-tail is a healthy animal. Unless weakened by starvation, it has little to fear from disease or parasites.

Nevertheless the deer population has had its ups and downs. The mainstay of the Indian and the pioneer, their numbers dwindled under heavy hunting pressure. Early Pennsylvanians hunted them by firelight from boats, from tree scaffolds, with dogs and with snares and gun traps. They were hunted for the market relentlessly. Deer meat sold for 2 cents a pound and was plentiful in Pittsburgh in the winter of 1762, according to James Kenny.

OAK MAST or acorns are a favorite winter food for deer. If there is a good mast crop, deer herds have a better chance of surviving hard winter months and lean early spring seasons.

By the 1890's deer were rare everywhere in the State.

An abrupt change in the fortunes of Pennsylvania wildlife came about with the establishment of a State Game Commission in 1896. Market hunting, use of dogs, and shooting at salt licks were all prohibited. Pennsylvania's first game law passed in 1721 ostensibly protected the deer from January 1 through July 1. The use of dogs for deer hunting was officially outlawed as early as 1873, but both laws were blandly ignored until the Game Commission took to the field.

Between 1906 and 1924, 1,192 deer from Michigan, New Hampshire, New Jersey, Maine, Ohio, Kentucky, and local Pennsylvania breeders were purchased and released. In 1905 buckshot was outlawed. In 1907 the Buck Law was passed and does were to receive complete protection for the next 16 years. The total deer kill in 1907 was only 300 animals. Just 30 years later, close to 250,000 were legally harvested in Pennsylvania in one season.

This tremendous increase came about because of hunting regulations, plus a forest that was springing up again in the wake of the lumberman. With lots of browse, their natural predators extinct, and men held at bay, deer multiplied in a Malthusian spiral. At its highest point the Pennsylvania herd probably numbered over a million head.

Of course, the inevitable happened. More mouths were competing for less browse as Penn's Woods gradually grew out of the deer's reach and shaded out the undergrowth. Deer starved in great numbers, reproductive capacity was reduced and antler development was poor. Worse yet, the forest was unable to reproduce itself. Other species such as grouse and snowshoe hare were also affected as the range deteriorated.

With the introduction of antlerless deer seasons and the increase of license quotas, the deer were reduced to a more reasonable level and are presently more nearly in balance with their environment. The Pennsylvania Game Commission enhances the natural food production of the forest for deer by making browse cuttings in poor quality timber stands and by selling timber products in valuable stands.

Today, the white-tail has become one of Pennsylvania's most valuable and popular wildlife crops. Its future depends upon an adequate harvest of the annual surplus. Most everywhere the deer is found, it is its own worst enemy and its numbers must be controlled if it is to continue to prosper as a game animal in this Commonwealth.

Subspecies in Pennsylvania: Odocoileus virginianus borealis Miller.

Range: Throughout the State except possibly along the southern border.

Odocoileus virginianus virginianus (Zimmerman).

Range: May enter the State along the southern border.

WHAT MAMMAL IS THAT?

(First, make sure that you have a *mammal.* If it has hair, and is obviously not a spider, then follow the key step by step.)

1.	Hindfoot with monkey-like, clawless "thumb"	Opossums	p. 25
1.	No monkey-like, clawless "thumb"	Non-opossums	go to 2
2.	Wings	Bats	go to 56
2.	No wings	Non-bats	go to 3
3.	Eyes not visible (hidden in fur or under skin)	Moles & Shrews	go to 47
3.	Eyes visible	Non-moles & Non-shrews	go to 4
4.	Two large hoofs on each foot	Deer & Elk	go to 21
4.	Claws rather than hoofs	Keep going	go to 5
5.	Ears longer than tail	Rabbits	go to 22
5.	Ears shorter than tail	Non-rabbits	go to 6
6.	Four large, chisel-like incisors	Rodents	go to 24
6.	Incisors, small, 12 of them	Carnivores	go to 7
7.	Obviously a bear	Black bear	p. 193
7.	Obviously not a bear		go to 8
8.	Black mask over eyes	Raccoon	p. 198
8.	No mask		go to 9
9.	Cats		go to 10
9.	Dogs and foxes, skunks and weasels		go to 11
10.	Tail shorter than hindfoot	Wild cat	p. 223
10.	Tail longer than hindfoot	Meow!	
11.	Form dog-like. Muzzle long and pointed		go to 12
11.	Form not dog-like. Muzzle short	Skunks & Weasels	go to 15
12.	Fur bright red-brown, legs black, tail tip white	Red fox	p. 185
12.	Not red-brown with black legs or a white-tipped tail		go to 13
13.	Foxy-looking, back deep grizzled-gray, tail tip black	Gray fox	p. 190
13.	Dog-like, tawny, lightly grizzled with gray	maybe dog maybe coyote	

14. Black and white back ..... go to 15
14. Some shade of brown or (in winter) pure white ..... go to 16

15. No more than two white stripes runing down back. Gets "fuming mad" when annoyed. Don't annoy. ..... Striped skunk ..... p. 215
15. Four white stripes down back breaking into irregular white bars on flanks. Just as potent ..... Spotted skunk ..... p. 213

16. Belly fur essentially same color as back ..... go to 17
16. Belly fur white ..... go to 19

17. Throat yellow or buff ..... Pine marten
17. Throat not yellow or buff (may be spotted with white) ..... go to 18

18. Tail heavy, covered with short hair, not bushy ..... Otter ..... p. 219
18. Tail not heavy, bushy with glistening hair ..... Mink ..... p. 209

19. Tail 2 inches long or more, with a black tip ..... go to 20
19. Tail less than 1½ inches, no black tip ..... Least weasel ..... p. 202

20. Tail about twice as long as the hindfoot (heel to toe) ..... Ermine ..... p. 201
20. Tail about three times as long as hindfoot ..... Long-tailed weasel .. p. 205

21. Smaller than a cow. Tail large, frisky and great for making trout flies. Rump not lighter than sides ..... White-tailed deer ... p. 230
21. Cow size or larger. Tail stubby. Rump lighter than sides. Strictly protected, even if it is the biggest deer you ever saw! ..... Elk ..... p. 225

22. Hindfoot (heel to toe) measures 5 inches or more. Turns white in winter. ..... Snowshoe hare ..... p. 97
22. Hindfoot measures 4 inches or less. Animal remains brown in winter. ..... go to 23

23. The animal has been identified by a competent biologist as an eastern cottontail. (This is more than facetiousness. These two cannot be identified

readily in the field. Read the life history accounts of both.) ..... Eastern cottontail p. 89

23. The animal has been identified by a competent biologist as a New England cottontail ..... New England cottontail ..... p. 94

24. Tail flat, wide, scaly ..... Beaver ..... p. 129
24. Tail not flat and wide ..... go to 25

25. Tail bushy ..... Squirrels ..... go to 26
25. Tail not bushy ..... go to 33

26. Tail less than ¼ of total length. Incisors white ..... Woodchuck ..... p. 106
26. Tail longer. Incisors yellow or orange ..... go to 27

27. Back striped ..... go to 28
27. No stripes ..... go to 29

28. Thirteen narrow stripes, some broken into lines and dots, running down back and sides ..... 13-lined ground squirrel ..... p. 111
28. Five black and two white stripes running down back and sides ..... Chipmunk ..... p. 101

29. Furry, gliding membrane stretching from wrist to ankle ..... go to 13
29. No ..... go to 32

30. Blow on belly fur. Hairs are snow-white to the roots ..... Eastern flying squirrel ..... p. 124
30. Hairs on belly white with a gray base . Northern flying squirrel ..... p. 128

31. Back reddish-brown. Tail less than 6 inches long. Ears tufted in winter .. Red squirrel ..... p. 121
31. Back some other color. Tail over 6 inches long (if adult). Ears never tufted.

32. Belly tawny. Tail gray and orange .. Fox squirrel ..... p. 117
32. Belly white, often streaked with brown ..... Gray squirrel ..... p. 114
(Just to make things difficult, some fox squirrels answer this description. All gray squirrels will have a tiny pin-like tooth immediately in front of the first large cheek tooth. Fox squirrels don't.)

32. All black ..... Gray squirrel ..... p. 114

33. Tail covered with sharp spines. (If in doubt pick up animal by tail, all doubt will vanish.) ..... Porcupine ..... p. 181
33. Tail not covered with quills ..... go to 34

34. Upper incisors deeply grooved. Hind legs long and kangaroo-like. ..... go to 35
34. Upper incisors not deeply grooved. Hind legs not kangaroo-like. ..... go to 36

35. Tail with a white tip. Sides bright orange-yellow ..... Woodland jumping mouse ..... p. 179
35. Tail without a white tip. Sides dull yellow ..... Meadow jumping mouse ..... p. 176

36. Rat-sized animal. Body (minus tail) more than five inches long when adult ..... go to 37
36. Mouse-sized. Body less than 5 inches long ..... go to 40

37. Tail hairy, white below, gray above .. Wood rat ..... p. 144
37. Tail naked except for scattered bristles, scaly, all one color ..... go to 38

38. Tail flattened laterally. Hind toes webbed ..... Muskrat ..... p. 158
38. Tail round (like a rat-tailed file). Hind toes not webbed ..... go to 39

39. Fur black ..... Black rat ..... p. 166
39. Fur gray-brown ..... Norway rat ..... p. 168

(The rice rat is believed to be extinct in the state. If you don't live in the extreme southeastern corner of the state, forget it).

40. Belly fur pure white contrasting sharply with upperparts ..... go to 41
40. No. ..... go to 42

41. Tail not markedly hairy, not sharply divided white below, dark above, about ½ the total length of the mouse ..... Fisher's deer mouse . p. 138
41. Tail hairy, sharply divided white below, dark above. Several forms occur. One *(bairdii)* has a short tail less

½ of total length and lives in bare areas, beaches, road cuts, etc. The other (the *gracilis, nubiterrae* group), live in deep mountain forest and have tails more than ½ the total length of the animal.

42. Tail as long as body. Body gray. . . . House mouse . . . . . p. 172
42. Tail shorter than body. Back some shade of brown. . . . . go to 43

43. Tail longer than hindfoot . . . . . go to 45
43. Tail shorter than hindfoot . . . . . go to 44

44. Upper incisors with a shallow groove running down them. . . . . Bog lemming . . . . . p. 163
44. No shallow groove . . . . . Pine mouse . . . . . p. 156

45. Back bright reddish-brown . . . . . Red-backed mouse . . p. 147
45. Back dark, grizzled brown . . . . . go to 46

47. Front feet enlarged and paddle-like . . Moles . . . . . go to 48
47. Front feet not enlarged . . . . . Shrews . . . . . go to 50

48. Tail more than 2 inches long. Nose ringed with tiny tentacles . . . . . Star-nosed mole . . . . p. 55
48. Tail less than an inch long. Nose sharp. . . . . go to 49

49. Tail covered with coarse, black bristles . . . . . Hairy-tailed mole . . . p. 48
49. Tail bare . . . . . Eastern mole . . . . . p. 51

50. Tail short, less than one inch. . . . . go to 51
50. Tail longer than one inch. . . . . go to 52

51. Size large. Total length more than 4 inches. (This is the one the cat generally drags in.) . . . . . Short-tailed shrew . . p. 42
51. Size small. Total length less than 3¾ inches. . . . . Least shrew . . . . . p. 45

52. Third unicuspid reduced. (This isn't going to help you a bit unless you have at least 10X magnification, but it's the only handy field character. See sketch.) . . . . . Pygmy shrew . . . . p. 40
52. Third unicuspid not reduced. (You still need magnification. Sorry.) . . . . . go to 53

53. Total length more than 5 inches. Hindfoot fringed with tiny bristles . . Water shrew . . . . . p. 32
53. Total length considerably less than

5 inches. Hindfeet not fringed with tiny bristles. ..... go to 54

54. Tail 2 inches long and not tapered. . . Rock shrew ..... p. 38
54. Tail less than 2 inches long, tapering. ..... go to 55

55. Total length usually more than 4 inches. Color gray-brown. ..... Smoky shrew ..... p. 36
(These two species are easily confused and there's just no cure for it. If in doubt contact a natural history museum with your specimen.)
55. Total length less than 4 inches. Color dark-brown. ..... Masked shrew ..... p. 30

56. Flight membrane between hindfeet and tail, almost entirely bare. ..... go to 60
56. Flight membrane furry on top. ..... go to 57

57. Fur of back black, frosted with white. Flight membrane between hind legs and tail furry only on the half closest to the body. ..... Silver-haired bat ..... p. 75
57. Fur of back, red, fawn, brown or multicolored, frosted with white. Tail membrane completely furred on top. ..... go to 58

58. Large. Wing span over 14 inches (when adult). Throat yellow. ..... Hoary bat ..... p. 85
58. Smaller. Wing span about 12 inches. Throat not yellow. ..... go to 59

59. Color of back red (male), fawn color (female). ..... Red bat ..... p. 81
59. Color of bat deep brown ..... Seminole bat ..... p. 84

60. Large. Wing span 10 inches or more. Total length, including tail, over 4 inches. ..... Big brown bat ..... p. 78
60. Small. Wing span less than 10 inches. Total length including tail less than 4 inches. ..... go to 61

61. Fur light brown or yellowish. Skin of forearm reddish-brown. ..... Pygmy bat ..... p. 77
61. Fur dark, brown or black. Skin of forearm black. ..... go to 62

62. Tragus short (less than 4 millimeters), rounded at tip. ..... Evening bat ..... p. 87
(Sketch of tragus)

62. Tragus long, more than 4 millimeters. Pointed. ..... go to 63

63. When the ears are laid forward they definitely extend beyond the end of the nose. ..... Keen's bat ..... p. 70
(This can fool you, so watch it. The ears of the other bats in this category reach the nose and may extend just slightly beyond, but those of Keen's bat overlap a full sixteenth of an inch.)

63. They don't. ..... go to 64

64. Blow on the back fur to separate the hairs. Hairs tricolored—black, followed by a narrow band of gray, tipped with brown. ..... Indiana bat ..... p. 71

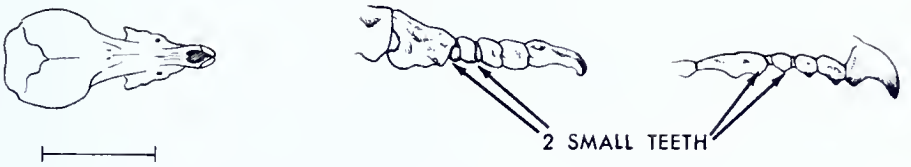
64. Blow again. Hairs bicolored, no gray band ..... go to 65..

65. Black mask. Keeled calcar (sketch). Distance from elbow to wrist less than 1 1/3 inches (34 mm). ..... Leib's bat ..... p. 73

65. No mask, no keel on calcar, elbow to wrist, greater than 1 1/3 inches (34 mm). ..... Little brown bat .... p. 66

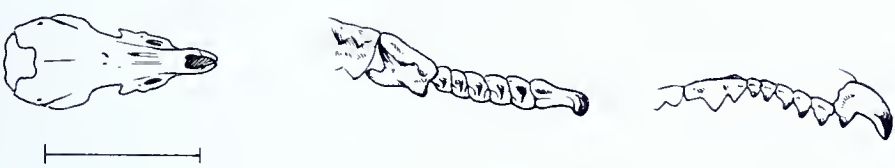
	TOOTH FORMULA						BREEDING DATA		
	Incisors	Canines	Premolars	Molars	No. of teeth on both sides	Total number of teeth	Gestation period in days	Number of young per litter	Number of litters per year
Didelphis marsupialis	5/4	1/1	3/3	4/4 =	26/24 =	50	13	3-14	1
Sorex cinereus	3/1	1/1	3/1	3/3 =	20/12 =	32	...	4-10	...
Sorex palustris	3/1	1/1	3/1	3/3 =	20/12 =	32	...	6-8	...
Sorex fumeus	3/1	1/1	3/1	3/3 =	20/12 =	32	...	4-6	2±
Sorex dispar	3/1	1/1	3/1	3/3 =	20/12 =	32	...	2-4	2?
Microsorex hoyi	3/1	1/1	3/1	3/3 =	20/12 =	32	...	6?	...
Blarina brevicauda	3/1	1/1	3/1	3/3 =	20/12 =	32	21	5-7	...
Cryptotis parva	3/1	1/1	2/1	3/3 =	18/12 =	30	...	3-5	...
Parascalops breweri	3/3	1/1	4/4	3/3 =	22/22 =	44	30-40	4-5	1?
Scalopus aquaticus	3/2	1/0	3/3	3/3 =	20/16 =	36	40±	4-5	...
Condylura cristata	3/3	1/1	4/4	3/3 =	22/22 =	44	...	3-6	1?
Myotis lucifugus	2/3	1/1	3/3	3/3 =	18/12 =	38	...	1-2	1
Myotis keenii	2/3	1/1	3/3	3/3 =	18/20 =	38	...	...	1
Myotis subulatus	2/3	1/1	3/3	3/3 =	18/20 =	38	...	...	1
Lasionycteris noctivagans	2/3	1/1	2/3	3/3 =	16/20 =	36	...	1	2
Pipistrellus subflavus	2/3	1/1	2/2	3/3 =	16/18 =	34	...	2	1
Eptesicus fuscus	2/3	1/1	1/2	3/3 =	14/18 =	32	...	1-2	1

MICROSOREX



CRYPTOTIS

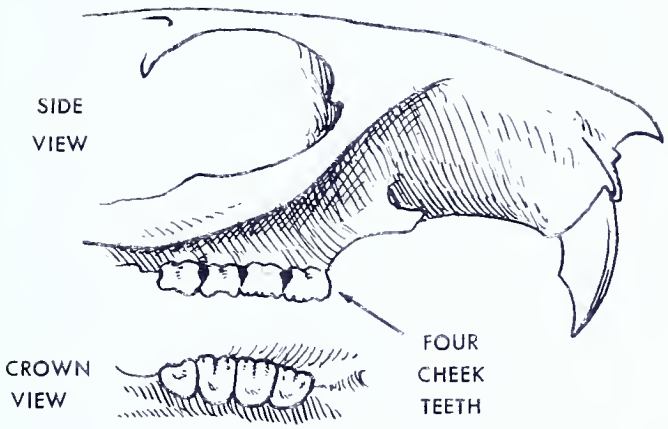
SOREX



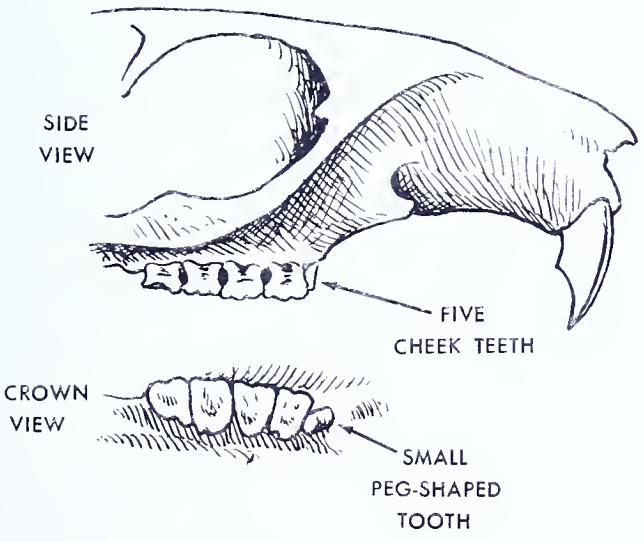
BLARINA

	TOOTH FORMULA						BREEDING DATA		
	Incisors	Canines	Premolars	Molars	No. of teeth on both sides	Total number of teeth	Gestation period in days	Number of young per litter	Number of litters per year
Lasiurus borealis	1/3	1/1	2/2	3/3	= 14/18	= 32	...	1-4	1
Lasiurus seminolus	1/3	1/1	2/2	3/3	= 14/18	= 32	...	...	1?
Lasiurus cinereus	1/3	1/1	2/2	3/3	= 14/18	= 32	...	2	1
Nycticeius humeralis	1/3	1/1	1/2	3/3	= 12/18	= 30			
Sylvilagus floridanus	2/1	0/0	3/2	3/3	= 16/12	= 28	30	4-7	3-5
Sylvilagus transitionalis	2/1	0/0	3/2	3/3	= 16/12	= 28	30	4-6	3±
Lepus americanus	2/1	0/0	3/2	3/3	= 16/12	= 28	35±	1-5	1-2
Tamias striatus	1/1	0/0	1/1	3/3	= 10/10	= 20	31	2-7	1-2
Marmota monax	1/1	0/0	2/1	3/3	= 12/10	= 22	31±	3-6	1
Citellus tridecemlineatus	1/1	0/0	2/1	3/3	= 12/10	= 22	28	7-14	2±
Sciurus carolinensis	1/1	0/0	2/1	3/3	= 12/10	= 22	44	3-5	1-2
Sciurus niger	1/1	0/0	1/1	3/3	= 10/10	= 20	...	2-5	1-2
Tamiasciurus hudsonicus	1/1	0/0	1/1	3/3	= 10/10	= 20	...	4-6	1-2
Glaucomys volans	1/1	0/0	2/1	3/3	= 12/10	= 22	40	3-5	1-2
Glaucomys sabrinus	1/1	0/0	2/1	3/3	= 12/10	= 22	...	3-5	1-2
Castor canadensis	1/1	0/0	1/1	3/3	= 10/10	= 20	125	1-6+	1
Oryzomys palustris	1/1	0/0	0/0	3/3	= 8/8	= 16			

FOX SQUIRREL



GRAY SQUIRREL



	TOOTH FORMULA						BREEDING DATA		
	Incisors	Canines	Premolars	Molars	No. of teeth on both sides	Total number of teeth	Gestation period in days	Number of young per litter	Number of litters per year
Peromyscus maniculatus	1/1	0/0	0/0	3/3	= 8/8	= 16	21	3-6	4-5
Peromyscus leucopus	1/1	0/0	0/0	3/3	= 8/8	= 16	21	2-6	4-5
Neotoma floridana	1/1	0/0	0/0	3/3	= 8/8	= 16	33	2-3	2-3
Clethrionomys gapperi	1/1	0/0	0/0	3/3	= 8/8	= 16	15-20?	3-6	2?
Microtus pennsylvanicus	1/1	0/0	0/0	3/3	= 8/8	= 16	21	5-8	8-9±
Microtus chrotorrhinus	1/1	0/0	0/0	3/3	= 8/8	= 16	...	3-4	2±
Pitymys pinetorum	1/1	0/0	0/0	3/3	= 8/8	= 16	21	3-6	3-4±
Ondatra zibethicus	1/1	0/0	0/0	3/3	= 8/8	= 16	25-30	6-10	2±
Synaptomys cooperi	1/1	0/0	0/0	3/3	= 8/8	= 16	...	3-5	...
Rattus rattus	1/1	0/0	0/0	3/3	= 8/8	= 16	21?	...	...
Rattus norvegicus	1/1	0/0	0/0	3/3	= 8/8	= 16	21-22	6-22	12
Mus musculus	1/1	0/0	0/0	3/3	= 8/8	= 16	18-21	3-10	10±
Zapus hudsonius	1/1	0/0	1/0	3/3	= 10/8	= 18	18-21	6-8	2-3
Napaeozapus insignis	1/1	0/0	0/0	3/3	= 8/8	= 16	29±	3-6	1-2
Erethizon dorsatum	1/1	0/0	1/1	3/3	= 10/10	= 20	210	1	1
Phocoena phocoena	—	—	—	—	16-27/16-27	= 32-54	...	1?	1?
Canis latrans	3/3	1/1	4/4	2/3	= 20/22	= 42	65±	5-8	1

	TOOTH FORMULA							BREEDING DATA		
	Incisors	Canines	Premolars	Molars	No. of teeth on both sides	Total number of teeth		Gestation period in days	Number of young per litter	Number of litters per year
Vulpes fulva	3/3	1/1	4/4	2/3	= 20/22	= 42		56±	5-9	1
Urocyon cinereoargenteus	3/3	1/1	4/4	2/3	= 20/22	= 42		...	3-7	...
Ursus americanus	3/3	1/1	4/4	2/3	= 20/22	= 42		210±	1-3	1
Procyon lotor	3/3	1/1	4/4	2/2	= 20/20	= 40		65±	3-6	1
Mustela erminea	3/3	1/1	3/3	1/2	= 16/18	= 34		...	5-7	...
Mustela rixosa	3/3	1/1	3/3	1/2	= 16/18	= 34		...	4-6	2
Mustela frenata	3/3	1/1	3/3	1/2	= 16/18	= 34		270?	5-8	...
Mustela vison	3/3	1/1	3/3	1/2	= 16/18	= 34		52±	4-9	...
Spilogale putorius	3/3	1/1	3/3	1/2	= 16/18	= 34		...	4-6	1
Mephitis mephitis	3/3	1/1	3/3	1/2	= 16/18	= 34		70	4-9	1
Lutra canadensis	3/3	1/1	4/3	1/2	= 18/18	= 36		...	1-3	1
Lynx rufus	3/3	1/1	2/2	1/1	= 14/14	= 28		...	1-4	1
Phoca vitulina	3/2	1/1	4/4	1/1	= 18/16	= 34		285±	1	1
Cystophora cristata	2/1	1/1	4/4	1/1	= 16/14	= 30		335?	1	1
Cervus canadensis	0/3	1/1	3/3	3/3	= 14/20	= 34		255	1	1
Odocoileus virginianus	0/3	0/1	3/3	3/3	= 12/20	= 32		210	1-2	1

MEASUREMENTS AND WEIGHTS OF PENNSYLVANIA MAMMALS

Note: * = weight in pounds.

	Total Length				*Tail*				*Hind foot*				*Ear*				*Weight*			
	mm.		in.		mm.		in.		mm.		in.		mm.		in.		gms		oz.	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
Didelphis marsupialis	650	900	25.6	35.4	217	37.5	8.5	14.8	62	79	2.4	3.1	37	61	1.4	2.4	1814	4536	4.0*	9.9*
Sorex cinereus	75	110	3.0	4.4	28	48	1.1	1.9	10	13	0.4	0.5					3.4	5.5	0.1	0.2
Sorex dispar	110	135	4.4	5.4	50	64	2.0	2.6	14	15	0.5	0.6					5	6	0.2	0.2
Sorex fumeus	110	126	4.4	5.0	45	50	1.8	2.0	13	15	0.5	0.6					6	11	0.2	0.4
Sorex palustris	144	158	5.8	6.3	65	72	2.6	2.9	19	21	0.7	0.8					10	15	0.4	0.5
Microsorex hoyi	78	101	3.1	4.0	28	35	1.1	1.4	8.5	11	0.3	0.4					2.3	4	0.1	0.1
Blarina brevicauda	100	132	4.0	5.3	18	32	0.7	1.3	12	17	0.5	0.7					12.0	23.5	0.4	0.8
Cryptotis parva	75	89	3.0	3.6	13	20	0.5	0.8	9	11	0.4	0.4					4	6	0.1	0.2
Parascalops breweri	145	168	5.8	6.7	23	35	0.9	1.4	18	20	0.7	0.8					40	64	1.0	2.2
Scalopus aquaticus	143	205	5.7	8.2	19	38	0.8	1.5	18	24	0.7	1.0					65	140	2.3	4.9
Condylura cristata	175	203	7.0	8.1	65	84	2.6	3.4	26	28	1.0	1.1					37	76	1.3	2.7
Myotis lucifugus	79	94	3.2	3.8	32	44	1.3	1.8	9	11	0.4	0.4	12	16	0.5	0.6	6	9	0.2	0.3
Myotis keenii	79	91	3.2	3.6	36	40	1.4	1.6	8	10	0.3	0.4	14	18	0.6	0.7	6	9	0.2	0.3
Myotis sodalis	71	90	2.8	3.6	28	42	1.1	1.7	7	8	0.3	0.3	10	14	0.4	0.6	6	9	0.2	0.3
Myotis subulatus	74	80	3.0	3.2	31	34	1.2	1.4	6.5	7	0.3	0.3	12	15	0.5	0.6	5	8	0.2	0.3
Lasionycteris noctivagans	95	112	3.8	4.5	36	48	1.4	1.9	8	11	0.3	0.4	14	17	0.6	0.7	6	10	0.2	0.3
Pipistrellus subflavus	80	89	3.2	3.6	36	49	1.4	2.0	8	12	0.3	0.5					6	11	0.2	0.4

Eptesicus fuscus	97	115	3.9	4.6	35	48	1.4	1.9	10	15	0.4	0.6	16	19	0.6	0.8	11	16	0.4	0.6
Lasiurus borealis	94	112	3.7	4.5	42	54	1.7	2.2	8	10	0.3	0.4	9	13	0.4	0.5	7	14	0.2	0.5
Lasiurus seminolus		112		4.5		48		1.9		10		0.4								
Lasiurus cinereus	133	145	5.3	5.8	52	61	2.1	2.1	10	14	0.4	0.6	19?		0.8?		25	30	0.9	1.1
Nycticeius humeralis	92	95	3.7	3.8	35	42	1.4	1.7	7	9	0.3	0.4	13±		0.5?		10?		0.4?	
Sylvilagus floridanus	382	488	15	19.2	32	72	1.2	2.8	85	112	3.3	4.4	56	70	2.2	2.7	1035	1482	2.2*	3.2*
Sylvilagus transitionalis	382	425	15	16.7	43	52	1.6	2.0	89	102	3.5	4.0	58	67	2.2	2.6	718	1220	1.6*	2.7*
Lepus americanus	473	520	18.6	20.5	40	61	1.5	2.4	130	147	5.1	5.8	68	78	2.6	3.0	1510	1588	2.1*	3.5*
Oryctolagus																				
Tamias striatus	266	265	9.0	10.6	66	109	2.6	4.4	31	41	1.2	1.6					65	110	2.3	3.9
Marmota monax	528	650	20.8	25.6	100	170	3.9	6.7	75	102	3.0	4.0	26	43	1.0	1.7	2041	5216	4.5*	11.5*
Citellus tridecemlineatus	267	279	10.5	11.0	92	100	3.6	3.9	34	39	1.3	1.5	7	12	.28	.47	121	148	4.3	5.2
Sciurus carolinensis	419	538	16.5	21.2	164	248	6.5	9.8	59	75	2.3	2.9	23	38	.91	1.5	419	685	14.8	24.1
Sciurus niger	510	592	20.1	23.3	218	280	8.6	11.0	69	79	2.7	3.1	25	33	.98	1.3	879	1017	1.9*	2.2*
Tamiasciurus hudsonicus	241	352	9.5	13.9	100	165	3.9	6.5	42	58	1.7	2.3	17	30	.67	1.1	126	234	4.4	8.2
Glaucomys volans	210	253	8.3	10.0	79	130	3.1	5.1	26	35	1.0	1.3	15	23	.59	.91	43	86	1.5	3.0
Glaucomys sabrinus	246	279	9.7	11.0	100	128	3.9	5.0	35	39	1.3	1.5	21	26	.83	1.0	62	123	2.1	4.3
Castor canadensis	885	1350	35.4	54.0	240	450	9.6	18.0	150	205	6.0	8.0	32	47	1.3	1.9			26.0*	90.0*
Oryzomys palustris	228	311	9.1	12.2	102	185	4.1	7.4	28	32	1.1	1.3	15	17	0.6	0.7			1.5	3.0
Peromyscus maniculatus bairdii	121	160	4.8	6.4	50	70	2.0	2.8	16	19	0.6	0.8	12	14	0.5	0.6	10	24	0.4	0.8
Peromyscus maniculatus gracilis	158	203	6.3	8.1	70	107	2.8	4.3	19	23	0.8	0.9					12	30	0.4	1.1

MEASUREMENTS AND WEIGHTS OF PENNSYLVANIA MAMMALS—Continued

Note: * = weight in pounds.

	Total Length				*Tail*				*Hind foot*				*Ear*				*Weight*			
	mm.		in.		mm.		in.		mm.		in.		mm.		in.		gms.		oz.	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
Peromyscus maniculatus nubiterrae	179	205	7.2	8.2	90	109	3.6	4.4	20	22	0.8	0.9	19	21	0.8	0.8	16	22	0.6	0.8
Peromyscus leucopus	150	200	6.0	8.0	60	95	2.4	3.8	18	24	0.7	1.0	13	16	0.5	0.6	15	30	0.5	1.1
Neotoma floridana	381	465	15.2	18.3	162	215	6.4	8.5	39	47	1.6	1.9	25	35	1.0	1.4	273	447	9.6	15.7
Clethrionomys gapperi paludicola	145	153	5.8	6.1	36	45	1.4	1.8	18	20	0.7	0.8	13	15	0.5	0.6	30	38	1.1	1.3
Clethrionomys gapperi gapperi	120	158	4.8	6.3	30	50	1.2	2.0	17	21	0.7	0.8	12	16	0.5	0.6	16	24	0.6	0.8
Microtus pennsylvanicus	130	190	5.2	7.6	35	65	1.4	2.6	18	24	0.7	1.0	12	16	0.5	0.6	20	65	0.7	2.3
Microtus chrotorrhinus	142	169	5.7	6.8	43	50	1.7	2.0	19	22	0.8	0.9					30	40	1.1	1.4
Pitymys pinetorum	110	140	4.4	5.6	17	24	0.7	1.0	16	20	0.6	0.8	10	12	0.4	0.5	25	37	0.8	1.3
Ondatra zibethicus	484	640	19.4	25.6	221	315	8.7	12.6	68	91	2.7	3.6	19	32	0.8	1.3	728	1614	1.7*	3.5*
Synaptomys cooperi	115	145	4.6	5.8	15	24	0.6	1.0	16	20	0.6	0.8	10	13	0.4	0.5	25	45	0.8	1.6
Rattus rattus	325	450	13.0	18.0	155	250	6.2	10.0	31	40	1.2	1.6					120	340	4.2	11.9
Rattus norvegicus	320	450	12.8	18.0	125	200	5.0	8.0	30	43	1.2	1.7					200	475	7.0	16.6
Mus musculus	140	190	5.6	7.6	65	95	2.6	3.8	15	20	0.6	0.8	12	17	0.5	0.7	15	23	0.5	0.8
Zapus hudsonius	185	220	7.4	8.8	110	140	4.4	5.6	26	30	1.0	1.2					15	21	0.5	0.7
Napaeozapus insignis	215	250	8.6	10.0	130	150	5.2	6.0	30	33	1.2	1.3					20	25	0.7	0.9

Erethizon dorsatum	568	780	22.7	31.2	165	225	6.6	9.7	85	101	3.4	4.0	20	38	0.8	1.5	2041	7598	4.5*	16.6*
Canis latrans	1100	1300	44.0	52.0	300	390	12.0	15.6	180	215	7.2	8.6							25.0*	50.0*
Vulpes fulva	955	1080	37.6	42.5	318	460	12.5	18.1	154	178	6.1	7.0	82	102	3.2	4.0	3175	5216	6.9*	11.4*
Urocyon cinereoargenteus	870	1041	34.2	41.0	305	382	12.0	15.0	127	149	5.0	5.9	70	75	2.7	3.0	4082	4989	8.9*	10.8*
Ursus americanus			60	85			4.0	14.0			8.0	14.0			4.75	5.4			200.00*	600.00*
Procyon lotor	720	915	28.3	36.0	196	279	7.7	11.0	102	121	4.0	4.8	60	70	2.4	2.8	3969	15195	8.7*	33.2*
Mustela erminea–m	253	295	10.0	11.6	64	81	2.5	3.2	33	43	1.3	1.7	17	19	0.6	0.7	76	85	2.7	3.0
Mustela erminea–f	230	247	9.1	9.7	58	64	2.3	2.5	28	31	1.1	1.2	15	17	.59	.67	58	100	2.0	3.5
Mustela rixosa–m	189	206	7.4	8.1	32	38	1.2	1.5	20	25	0.79	0.98	10	14	0.39	0.55	59	59	2.1	2.1
Mustela rixosa–f	181	192	7.1	7.6	31	44	1.2	1.7	21	22	0.83	0.87	13	13	0.5	0.51	38	43	1.34	1.51
Mustela frenata–m	343	450	13.5	17.7	108	164	4.3	6.5	38	54	1.5	2.1	19	28	0.75	1.10	107	312	3.8	11.0
Mustela frenata–f	291	345	11.5	13.6	84	117	3.3	4.6	33	40	1.3	1.5	18	21	0.71	0.83	67	128	2.4	4.5
Mustela vison–m	533	684	21.0	26.9	181	235	7.1	9.3	57	75	2.2	3.0	24	27	0.94	1.06	540	723	1.2*	1.6*
Mustela vison–f	460	525	18.1	20.7	155	182	6.1	7.2	50	58	2.0	2.3	20	22	0.79	0.87	520	596	1.1*	1.3*
Spilogale putorius	400	550	16.0	22.0	180	220	7.2	8.8	45	50	1.8	2.0			1.0	1.12	475	1250	1.0*	2.7*
Mephitis mephitis	539	665	21.2	26.2	184	287	7.2	11.3	60	79	2.4	3.1	22	34	0.9	1.3	1134	3402	2.5*	7.4*
Lutra canadensis	1097	1200	43.2	47.2	411	440	16.1	17.3	125	132	4.9	5.2	18	27	0.7	1.1	7144	7484	15.6*	16.4*
Lynx rufus	760	1200	30.4	48.0	130	190	5.2	7.6	160	220	6.4	8.8			2.5	2.75			25.0*	35.0*
Phoca vitulina			60	72															*	300.00*
Cystophora cristata				126															*	850.0*
Cervus canadensis	2000	2975	80.0	119.0	80	210	3.2	8.4	465	660	18.6	26.4							500.0*	1100.0*
Odocoileus virginianus	1340	2060	53.6	82.4	150	330	6.0	13.2	360	520	14.4	20.8			5.5	9.0			100.0*	300.0*

NOTE: *m=male f=female*

MAMMALS OF PENNSYLVANIA

CHECK LIST

Order MARSUPIALIA (Marsupials)

Family DIDELPHIIDAE (Opossums)

1. *Didelphis marsupialis virginiana* Kerr—Opossum

Order INSECTIVORA (Moles and Shrews)

Family SORICIDAE (Shrews)

2. *Sorex cinereus cinereus* Kerr—Masked Shrew
3. *Sorex cinereus fontinalis* Hollister
4. *Sorex palustris albibarbis* (Cope)—Water Shrew
5. *Sorex fumeus fumeus* Miller—Smoky Shrew
6. *Sorex dispar dispar* Batchelder—Rock Shrew
7. *Microsorex hoyi thompsoni* (Baird)—Pygmy Shrew
8. *Blarina brevicauda kirtlandi* Bole and Moulthrop—Short-tailed Shrew
9. *Blarina brevicauda talpoides* (Gapper)
10. *Cryptotis parva parva* (Say)—Least Shrew

Family TALPIDAE (Moles)

11. *Parascalops breweri* (Bachman)—Hairy-tailed Mole
12. *Scalopus aquaticus aquaticus* (Linnaeus)—Eastern Mole
13. *Condylura cristata cristata* (Linnaeus)—Star-nosed Mole

Order CHIROPTERA (Bats)

Family VESPERTILIONIDAE (Highly specialized Bats)

14. *Myotis lucifugus lucifugus* (LeConte)—Little Brown Bat
15. *Myotis keenii septentrionalis* (Trouessart)—Keen's Bat
16. *Myotis sodalis* Miller and G. M. Allen—Indiana Bat
17. *Myotis subulatus leibii* (Audubon and Bachman)—Small-footed Bat
18. *Lasionycteris noctivagans* (LeConte)—Silver-haired Bat
19. *Pipistrellus subflavus obscurus* Miller—Pygmy Bat
20. *Pipistrellus subflavus subflavus* (F. Cuvier)
21. *Eptesicus fuscus fuscus* (Palisot de Beauvois)—Big Brown Bat
22. *Lasiurus borealis borealis* (Müller)—Red Bat
23. *Lasiurus seminolus* (Rhoads)—Seminole Bat
24. *Lasiurus cinereus cinereus* (Palisot de Beauvois)—Hoary Bat
25. *Nycticeius humeralis humeralis* (Rafinesque)—Evening Bat

Order LAGOMORPHA (Hares, Rabbits)

Family LEPORIDAE (Rabbits)

26. *Sylvilagus floridanus mallurus* (Thomas)—Eastern Cottontail
27. *Sylvilagus floridanus mearnsii* (J. A. Allen)
28. *Sylvilagus transitionalis* (Bangs)—New England Cottontail
29. *Lepus americanus virginianus* (Harlan)—Snowshoe Hare
30. *Oryctolagus cuniculus* (Linnaeus)—San Juan Rabbit
31. *Lepus europaeus hybridus* Desmarest—European Hare

Order RODENTIA (Rodents)

Family SCIURIDAE (Squirrels)

32. *Tamias striatus fisheri* A. H. Howell—Eastern Chipmunk
33. *Tamias striatus lysteri* (Richardson)
34. *Marmota monax monax* (Linnaeus)—Woodchuck
35. *Marmota monax rufescens* A. H. Howell
36. *Citellus tridecemlineatus tridecemlineatus* (Mitchill)—Thirteen-lined Ground Squirrel
37. *Sciurus carolinensis pennsylvanicus* Ord—Gray Squirrel
38. *Sciurus niger rufiventer* E. Geoffrey St.-Hilaire—Fox Squirrel
39. *Sciurus niger vulpinus* Gmelin
40. *Tamiasciurus hudsonicus loquax* (Bangs)—Red Squirrel
41. *Glaucomys volans volans* (Linnaeus)—Eastern Flying Squirrel
42. *Glaucomys sabrinus macrotis* (Mearns)—Northern Flying Squirrel

Family CASTORIDAE (Beavers)

43. *Castor canadensis canadensis* Kuhl—Beaver

Family CRICETIDAE (Native Rats and Mice)

44. *Oryzomys palustris palustris* (Harlan)—Rice Rat
45. *Peromyscus maniculatus bairdii* (Hoy and Kennicott)—Deer Mouse
46. *Peromyscus maniculatus gracilis* (LeConte)
47. *Peromyscus maniculatus nubiterrae* Rhoads
48. *Peromyscus leucopus noveboracensis* (Fischer)—White-footed Mouse
49. *Neotoma floridana magister* Baird—Eastern Wood Rat
50. *Clethrionomys gapperi gapperi* (Vigors)—Gapper's Red-backed Mouse
51. *Clethrionomys gapperi paludicola* Doutt
52. *Clethrionomys gapperi rupicola* E. L. Poole
53. *Microtus pennsylvanicus pennsylvanicus* (Ord)—Meadow Vole
54. *Microtus chrotorrhinus chrotorrhinus* (Miller)—Rock Vole

55. *Pitymys pinetorum scalopsoides* (Audubon and Bachman)—Pine Vole
56. *Ondatra zibethicus macrodon* (Merriam)—Muskrat
57. *Ondatra zibethicus zibethicus* (Linnaeus)
58. *Synaptomys cooperi cooperi* Baird—Southern Bog Lemming
59. *Synaptomys cooperi stonei* Rhoads

Family MURIDAE (Old World Rats and Mice)

60. *Rattus rattus* Linnaeus—Black Rat
61. *Rattus norvegicus norvegicus* (Berkenhout)—Norway Rat
62. *Mus musculus* Linnaeus—House Mouse

Family ZAPODIDAE (Jumping Mice)

63. *Zapus hudsonius americanus* (Barton)—Meadow Jumping Mouse
64. *Napaeozapus insignis insignis* (Miller)—Woodland Jumping Mouse

Family ERETHIZONTIDAE (American Porcupines)

65. *Erethizon dorsatum dorsatum* (Linnaeus)—Porcupine

Family CAPROMYIDAE (Hutias and Coypus)

66. *Myocaster coypus bonariensis* (E. Geoffroy St.-Hilaire)—Nutria

Order CETACEA (Whales and Porpoises)

Family DELPHINIDAE (Porpoises and Dolphins)

67. *Phocoena phocoena* (Linnaeus)—Atlantic Harbor Porpoise

Order CARNIVORA (Carnivores)

Family CANIDAE (Wolves, Coyotes, Dogs and Foxes)

68. *Canis latrans* Say—Coyote
69. *Vulpes fulva fulva* (Desmarest)—Red Fox
70. *Urocyon cinereoargenteus cinereoargenteus* (Schreber)—Gray Fox

Family URSIDAE (Bears)

71. *Ursus americanus americanus* Pallas—Black Bear

Family PROCYONIDAE (Raccoons)

72. *Procyon lotor lotor* (Linnaeus)—Raccoon

Family MUSTELIDAE (Mustelids)

73. *Mustela erminea cicognanii* Bonaparte—Ermine
74. *Mustela rixosa allegheniensis* (Rhoads)—Least Weasel
75. *Mustela frenata noveboracensis* (Emmons)—Long-tailed Weasel
76. *Mustela vison mink* Peale and Palisot de Beauvois—Mink
77. *Musela vison vison* Schreber
78. *Spilogale putorius putorius* (Linnaeus)—Eastern Spotted Skunk
79. *Mephitis mephitis nigra* (Peale and Palisot de Beauvois)—Skunk
80. *Lutra canadensis canadensis* (Schreber)—River Otter
81. *Lutra canadensis lataxina* F. Cuvier

Family FELIDAE (Cats)

82. *Lynx rufus rufus* (Schreber)—Bobcat

Order PINNIPEDIA (Seals and Walruses)

Family PHOCIDAE (Earless Seals)

83. *Phoca vitulina concolor* De Kay—Harbor Seal
84. *Cystophora cristata* (Erxleben)—Hooded Seal

Order ARTIODACTYLA (Even-toed Hoofed Mammals)

Family CERVIDAE (Deer)

85. *Cervus canadensis canadensis* Erxleben—Wapiti or Eastern Elk
86. *Cervus canadensis nelsoni* V. Bailey (introduced form)
87. *Odocoileus virginianus borealis* Miller—White-tailed Deer
88. *Odocoileus virginianus virginanus* (Zimmerman)

GLOSSARY

Albino: Congenital absence of all pigment in hair, skin, eyes and nails. Thus, the animal's hair is white and the skin and eyes are pink.

Antibrachial: Membrane leading from the shoulder to the wrist, on the leading edge of a bat's wing.

Auditory bullae: Rounded, thin-walled bony capsules which contain the inner ear mechanisms.

Blastula: Early stage of embryonic development characterized by a small, hollow sphere of cells.

Broom sedge: *Andropogon virginicus,* a coarse grass characteristic of poor, abandoned fields in some areas.

Browser: Herbivorous animal specializing in twigs, leaves, bark and buds of woody plants.

Calcar: Cartilaginous spur arising from the heel of a bat to help support the interfemoral membrane. A calcar is also found at the wrist of a flying squirrel.

Canadian life-zone: The "North Woods" of Canada. A forest belt of conifers south of the Arctic tundra, but north of the deciduous forest. Typical of southern Canada and the higher mountain summits of the Appalachian Mountains.

Canine Tooth: The eye-tooth. Easily identified in carnivores because of its great length. Used for slashing. Missing in rodents and rabbits. Missing or reduced in hoofed animals.

Carnassial: The shearing tooth of carnivores. Always the fourth premolar in the upper jaw and the first molar in the lower jaw.

Carnivore: A meat-eater. Usually refers to bears, dogs and foxes, cats, raccoons and members of the weasel family, in Pennsylvania.

Castorum: Waxy secretion of the anal glands of the beaver. Once used extensively in the fixing of perfumes.

Chiroptera: All bats. Word of Latin origin—literally, "finger-wing."

Commensal:	Literally, "common table." An animal like the house mouse, that depends upon another animal, such as man, for food and shelter.
Conifer:	A cone-bearing tree, such as pine, spruce, tamarack or fir.
Cusp:	One of the bumps or points on the grinding surface of any tooth.
Delayed implantation:	A condition found in some carnivores where a fertilized egg will develop to the blastula stage, then lie quiescent, perhaps for months, before implantation and further development.
Diastema:	Any natural toothless interval along a row of teeth.
Dorsal:	The back, or top surface.
Echo-location:	A guidance system in which the ear picks up sound waves bounced back from calls made by the animal itself. In the case of bats such calls are ultrasonic.
Fallopian tubes:	Ducts leading from the ovaries to the uterus.
Feral:	A domestic animal that has reverted to the wild.
Fetus:	An unborn, but well-developed young animal.
Foramen magnum:	The large opening at the base of the skull through which the spinal cord passes.
Gestation period:	Time between fertilization of egg and birth.
Gram:	1/32 of an ounce.
Heat:	Period of receptivity in the female when mating may take place.
Herbivore:	Plant-eater.
Hibernation period:	Period of inactivity in cold weather, characterized by reduced metabolism and coma-like appearance.
Hock:	"Ankle" joint of a hoofed animal.
Home range:	That area within which an animal spends its life.
Hormone:	Secretion of a ductless gland affecting body metabolism.

Implantation:	The fertilized egg attaching itself to the wall of the uterus.
Incisors:	Front teeth, never more than 6 in each jaw except in the opossum. The gnawing teeth of rodents.
Interfemoral membrane:	Thin skin stretching from ankle to ankle. In all bats from Pennsylvania this skin includes the tail.
Mammae:	Milk glands.
Mange:	Skin disease characterized by loss of hair and extensive skin eruptions.
Mast:	Tree fruits, such as acorns, beechnuts, etc.
Metatarsal gland:	Gland on the hindleg of a hoofed animal between the hoof and the hock.
Milk teeth:	The baby teeth—those that are shed and replaced by the permanent set.
Millimeter:	Approximately 1/25 of an inch.
Molar:	The grinding or the cheek teeth farthest back in the jaw. There are never more than 3 in each jaw (except opossums which have 4) and they are never preceded by milk teeth.
Musk:	Odorous glandular secretions.
Mutation:	An hereditary change.
Omnivorous:	Eating both plant and animal matter.
Ovary:	Ductless gland of the female which produces eggs and hormones essential for reproduction.
Ovulation:	Shedding of ripe egg or eggs from ovary to Fallopian tubes.
Pelage:	The hairy covering of a mammal.
Pinna:	That portion of the ear that sticks out beyond the head and acts as a sound collector.
Pituitary:	Ductless gland at base of brain.
Placental scar:	Scars left on uterine wall after birth of young. Marks site of attachment of fetus.
Pleistocene:	Span of geological time between one million and ten thousand years ago, during which successive glaciations took place.

Poverty grass:	*Danthonia spicata,* a coarse grass characteristic of poor soils and abandoned fields in some areas.
Predator:	An animal which lives by killing.
Premolar:	Anterior grinding teeth, often distinguished from true molar teeth only by the fact that they were preceded by milk teeth. There may by as many as 4 (fox) or none at all (meadow mouse).
Prime:	Term used to describe the condition of a pelt when the winter coat is completely in place and its commercial value is highest.
Rabies:	Virus disease affecting the nervous system. Usually fatal.
Refection:	Natural digestive process in rabbits (and suspected in some rodents and shrews) whereby the animals reingest their feces in order to complete the cycle of digestion.
Rut:	Breeding season, usually in reference to male hoofed animals.
Spermatozoa:	Male reproductive cells.
Sphincter:	Muscle surrounding an oriface of the body.
Spike buck:	Male deer with unbranched antlers.
Submaxillary gland:	Small gland under the lower jaw, supplying saliva to the mouth.
Supraorbital process:	Bony projection of the skull above the eye sockets.
Testes:	Male reproductive glands, producing spermatozoa and hormones.
Testosterone:	Hormone produced by the testes.
Tragus:	Small, fleshy structure, leaf-like and highly developed in bats, projecting upward inside front of ear.
Velvet:	Soft skin, filled wih blood vessels and covered with short, fuzzy hair, covering rapidly growing antlers.
Ventral:	Belly or underside; lower surface.
Yarding:	Winter concentration of hoofed animals.

INDEX

Page

Bat
- Big Brown ... 78
- Evening ... 87
- Hoary ... 85
- Indiana ... 71
- Keen ... 70
- Leib ... 73
- Little Brown ... 66
- Pygmy ... 77
- Red ... 81
- Seminole ... 84
- Silver-haired ... 75

Bear, Black ... 193
Beaver ... 129
Check List ... 258
Chipmunk ... 101
Deer, White-tailed ... 230
Elk, Eastern or Wapiti ... 225
Ermine ... 201
Fox
- Gray ... 190
- Red ... 185

Glossary ... 262
Ground Squirrel
- Chipmunk ... 101
- Thirteen-lined ... 111

Hare, Snowshoe ... 97
Identification Key ... 241
Lemming, Bog ... 163
Measurements and Weights ... 254
Mink ... 209
Mole
- Eastern ... 51
- Hairy-tailed ... 48
- Star-nosed ... 55

Mouse
- Deer ... 138
- House ... 172
- Jumping, Meadow ... 176
- Jumping, Woodland ... 179
- Meadow ... 150

Page

Pine ... 156
Red-backed ... 147
Rock Vole ... 154
White-footed ... 142
Muskrat ... 158
Opossum ... 25
Otter, River ... 219
Porcupine ... 181
Raccoon ... 198
Rabbit
Eastern Cottontail ... 89
New England ... 94
Snowshoe Hare ... 97
Rat
Black ... 166
Eastern Wood ... 144
Norway ... 168
Shrew
Least ... 45
Masked ... 30
Pygmy ... 40
Rock ... 38
Short-tailed ... 42
Smoky ... 36
Water ... 32
Skunk ... 215
Spotted ... 213
Squirrel
Eastern Flying ... 124
Northern Flying ... 128
Fox ... 117
Gray ... 114
Red ... 121
Tooth Formula ... 248
Wapiti or Eastern Elk ... 225
Weasel
Ermine ... 201
Least ... 202
Long-tailed ... 205
Mink ... 209
Otter ... 219
Wild Cat ... 223
Woodchuck ... 105

PHOTO CREDITS

Page 5, Red Fox, by George H. Harrison
Page 12, White-footed Mouse, by George H. Harrison
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Page 19, Elk, by Leonard Lee Rue III
Page 56, Star-nosed Mole, by Lynwood M. Chase
Page 63, Little Brown Bats, by George H. Harrison
Page 68, Little Brown Bats (top and bottom), by Leonard Lee Rue III
Page 83, Red Bats and young (top and bottom), by Leonard Lee Rue III
Page 89, Cottontail Rabbit, by Leonard Lee Rue III
Page 90, Rabbit hunter and dogs, by Norman E. Wengert
Page 95, Rabbit damage, by Leonard Lee Rue III
Page 107, Woodchuck, by Leonard Lee Rue III
Page 127, Flying Squirrels (top and bottom), by Leonard Lee Rue III
Page 133, Beaver trapping, PGC Photo by Steve Kish
Page 136, Beaver hides, by PGC
Page 153, Mouse nest, by Carnegie Museum
Page 159, Muskrat babies, by Leonard Lee Rue III
Page 161, Muskrat trappers, by Don Shiner
Page 186, Red Fox pup, by Leonard Lee Rue III
Page 190, Gray Fox, by Karl H. Maslowski
Page 194, Black Bear, by Leonard Lee Rue III
Page 196, Bear marks, by Don Shiner
Page 199, Raccoon, by Leonard Lee Rue III
Page 209, Mink, by Karl H. Maslowski
Page 210, Mink trapper, by Hal H. Harrison
Page 213, Spotted Skunk, by Leonard Lee Rue III
Page 215, Striped Skunk, by Leonard Lee Rue III
Page 220, Otter, by Leonard Lee Rue III
Page 222, Bobcat, by Leonard Lee Rue III
Page 226, Elk and Deer Kill, by PGC
Page 231, Whitetail Deer, by Alvin E. Staffan
Page 233, Whitetail Fawn, by Leonard Lee Rue III
Page 234, Buck rub, by Larry Pringle
Page 237, Deer foot, by Leonard Lee Rue III
Page 239, Mast crop, by Don Shiner
Page 266, Fawn Deer, by Leonard Lee Rue III
Page 267, Baby Beaver, by Leonard Lee Rue III
Page 268, Baby Raccoons, by Leonard Lee Rue III
Page 269, Baby Rabbit, by Leonard Lee Rue III

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